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Part I

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Repairing for Defense

By Louis R. Howson

POSSIBLY the title of this discussion should be "Repairing for War" rather than "Repairing for Defense," for the status of this nation is now that of a belligerent. It is becoming increasingly apparent, however, that, fundamentally, the difference is one of name only, an observation which, if it had been accepted long ago, might have been more constructive than now.

"Repairing for Defense" may be expressed in another way, by paraphrasing Gen. Forrest's famous statement, as "Doing the most with the least use of critical materials." This is a difficult matter in water works because practically all types and phases of water works construction and maintenance involve the use of what today are classed as "critical materials." Secretary Harry E. Jordan (1), acting for the A.W.W.A. Defense Committee, has developed an approximate estimate of critical materials required for only the maintenance and replacement of water works structures, from which the following is abstracted:

Annual Requirements in Tons—Figures Rounded

Iron	348,000
Steel	43,000
Copper	9,100
Lead	5,700
Nickel	200
Rubber	250

While even these quantities are but a relatively small percentage of the normal national total for each material, any procedure which will make it

A paper presented on April 9, 1942, at the Indiana Section Meeting, La Fayette, Ind., by Louis R. Howson, Alvord, Burdick & Howson, Cons. Engrs., Chicago.

possible to divert a part to war needs is worth while. To visualize this annual use in terms of armament—it is sufficient for the construction of 40 cruisers, 200 destroyers or 10,000 heavy tanks.

Emergencies are productive of new ideas. The water works systems in America are today confronted with the most important emergency, as related to critical materials, with which they have ever been confronted. Means by which the adequacy of existing facilities may be increased or restored, or their usefulness extended beyond what may ordinarily be accepted as their economic span of life, are worthy of consideration and adoption if they will result in making a greater proportion of critical materials available for tanks, guns, ships, and other essential war purposes. It is with the hope that this discussion may provoke further thought along these lines that it is offered.

It may well be argued that some of the suggestions hereinafter made are not economically sound and that funds available for the increased operating expenses resulting therefrom will not be available. As to the first criticism, it may be observed that any temporary lack of economy that will expedite the winning of the war is worth while. If we lose the war, there will be a different kind of economy anyway. Second, the ordinary water works in a growing community normally spends the equivalent of from 10 to 25 per cent of its gross revenues for new construction each year. During the present emergency, new construction is substantially at a standstill; accordingly, ample funds ordinarily expended for new construction will usually be available for increased operating expenses during the emergency.

Saving on Meter Metal

Let us first look at the water works cash register to see what can be done during the emergency to prolong the life of meters.

The A.W.W.A. Committee on Survival and Retirement Experience With Water Works Facilities has already compiled enough data to permit some interesting observations. Some thirty years ago when the author first became interested in water works valuation work, it was customary to ascribe a life expectancy of approximately twenty-five years to meters. As data accumulated it became apparent that the assumption of so short a life was purely arbitrary, but sufficient data were not available to show what the end-point should be. Appraisers began to pay more attention to maintenance and repair policies and "unaccounted-for water" and less to the period of service in fixing the percentage condition of water meters.

From the records already studied by the committee referred to above and from data secured through correspondence in connection with this discussion, it is interesting to note that, in nine water plants, in which approximately 360,000 $\frac{5}{8}$-in. meters have been installed, 320,000 of those

meters are still in service and only 40,000, or about 11 per cent, have been junked to date. Some of these systems have been completely metered for 50 years or more.

The basic data for this discussion of meter repair policy are shown in Table 1, in which the cities are designated by letters.

It will be noted that the percentage of meters junked to date varies from 1.6 to 26 per cent. It is further interesting to note that, in the four cities in which the largest percentage of meters has been junked, the current cost of repairs is approximately 50 per cent above that in the other five

TABLE 1

Data re $\frac{5}{8}$-In.-Meter Retirements Repair Costs

CITY	NO. OF METERS NOW IN SERVICE	NO. OF METERS JUNKED TO DATE	PERCENTAGE OF METERS JUNKED	NO. OF METERS REPAIRED IN 1941	PERCENTAGE REPAIRED IN 1941	APPROX. AVERAGE COST OF REPAIRS PER METER*
A	38,267	2,170	5.4	4,166	10.8	1.54
B	39,423	2,788	6.6	2,978	7.3	3.40±
C	20,879	2,433	10.9	3,087	14.8	1.20†
D	68,702	1,145	1.6	10,839	15.9	.93†
E	83,700	14,266	14.5	10,130	12.2	.966
F	19,923	4,179	17.3	982	5.0	2.55±
G	10,533	2,216	17.4	741	7.0	2.56‡
H	24,770	6,000±	20.0	3,594	13.9	1.685
I	13,496	4,712	26.0	1,780	13.2	3.60±
Average (not weighted).........			13.3		11.1	
Average F, G, H, and I.........			20.2		9.8	2.60
Average A, B, C, D, and E.....			7.8		12.2	1.60

* Not entirely comparable as to items included.

† Exclusive of removing and resetting.

‡ Including cost of removing and resetting.

Average unaccounted-for water of A, B, C, D, and E = 20.2 per cent.

Average unaccounted-for water of F, G, H, and I = 11.2 per cent.

cities. This is probably due, in part at least, to the character of the water measured, repair personnel and standard of maintenance as reflected in the lower average percentage of "water unaccounted for."

In all these cities the meters apparently have been reasonably well maintained, for the average of unaccounted-for water is 17.3 per cent, and only two cities reported over 20 per cent unaccounted for.

At the present time it would appear that most water departments scrap their meters when the cost of repairs is estimated to be approximately 50 per cent of the cost of a new meter. A. P. Kuranz (2) ascertained, from a questionnaire to which replies were secured from 34 cities, that meters were

scrapped when, on an average, repairs became 53½ per cent of the cost of a new meter.

The life span of a meter, before it is junked, is elastic. In these days of shortage of critical materials, it would seem that repair policies should be so modified as to continue in service during the emergency all meters other than those damaged beyond repair. This policy may result in raising the cost of repairs very slightly above normal, but the effect upon the unaccounted-for water should be substantially nil if the repairs are well made.

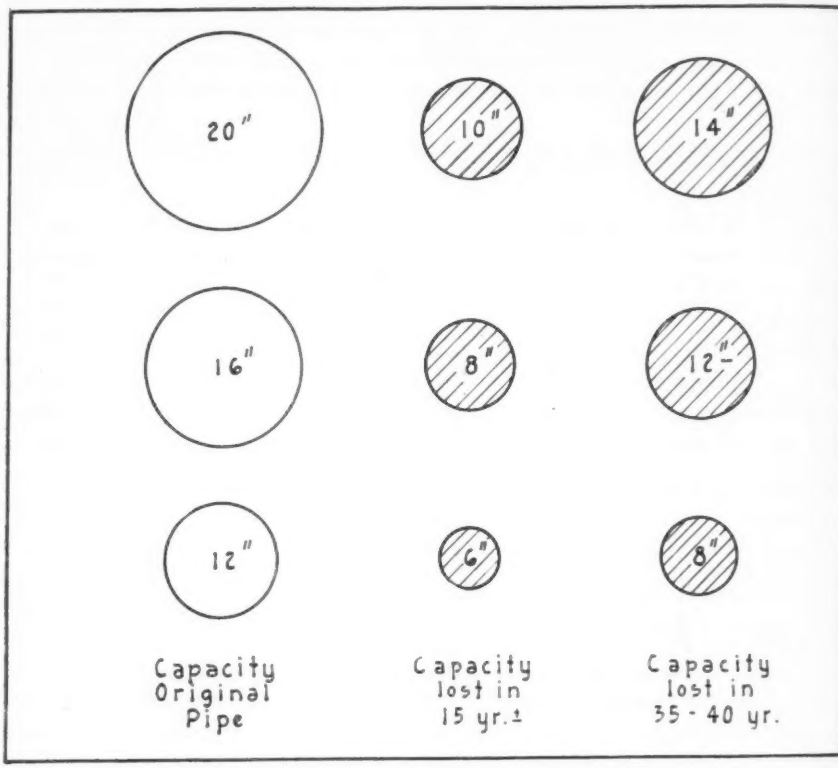

FIG. 1. Loss in Carrying Capacity of the Average Midwest Main

The fact that bronze is a more critical material than cast iron may indicate the use of cast iron instead of bronze in small meter casings, thus saving almost 80 per cent of the bronze now used for that purpose.

Carrying Capacity of Mains

In 1936, Edgar K. Wilson (3) presented a very valuable statistical paper, "Conditions of Mains in Typical American Cities." Analysis of the figures for sixteen midwest cities shows a rather close agreement with the

Williams-Hazen age-capacity trend curve, but the results are nevertheless startling in their presentation and importance. It shows that: (a) in the average midwest distribution system cast-iron pipe loses 20 per cent of its carrying capacity in the first 15 yr.; and (b) in the average midwest distribution system cast-iron pipe loses 40 per cent of its carrying capacity in 35 to 40 yr.

The magnitude of this loss may be visualized when it is understood that there are approximately 140,000 mi. of cast-iron pipe in the water works systems of this country, involving a valuation of approximately two billion dollars. The function of this pipe, of course, is to carry water.

Figure 1 is a visualization of the loss in carrying capacity of the average of midwest mains and of the increased capacity resulting from cleaning. It should be pointed out that, while the loss in carrying capacity in the first 15 yr. is approximately 20 per cent, the possible gain through cleaning the mains is 30 per cent of the reduced capacity. Similarly, whereas in 35 to 40 yr. the Williams-Hazen coefficient has decreased from 130 to 80, i.e. approximately 40 per cent, the possible gain in capacity by cleaning, over that in the old pipe, is approximately $62\frac{1}{2}$ per cent.

Possibly the question may be asked—What bearing does this have on "Repairing for Defense"? It is believed to be very pertinent, for if, instead of adding a 10-in. main to provide the capacity lost by a 20-in. main laid 15 yr. ago, the 20-in. main is cleaned, no critical materials have been used and the same capacity result obtained.

Cleaning a 35- to 40-yr. old 20-in. pipe will increase its capacity equivalent to laying a new 14-in. line.

Cleaning a 35- to 40-yr. old 16-in. main will add capacity equivalent to a new 12-in. main.

Cleaning a 35- to 40-yr. old 12-in. main will increase its capacity equivalent to laying a new 8-in. main.

The carrying capacity of the average midwest city distribution system could probably be increased 40 to 50 per cent by cleaning. No such wholesale cleaning is, of course, necessary or desirable. The importance of cleaning feeder mains as a prompt means of increasing deliveries to low pressure areas or of providing capacity to meet increased defense demands in restricted areas, however, should not be overlooked, particularly during the present necessity of conserving critical materials.

Cleaning the main will provide this capacity—probably for the duration of the war. The carrying capacity thus secured will probably be less permanent than if supplied by a new main, but the difference is one of time only. Making this recovery permanent is a challenge to the main cleaning companies and to the water supply technical personnel.

In cities operating a long force main from the pumping station to the distribution system, it is possible to increase the delivery 40 per cent by installing a booster station near the middle of the line and thus postponing duplication of the main.

Ground Storage Reservoirs

Another means of increasing the capacity of a distribution system is through the location of ground storage reservoirs at strategic locations.

TABLE 2

Use of Automobiles by 22 U.S. Water Utilities

CITY	NO. CARS AND TRUCKS	MILES OPERATED	1940 POPULATION	MILES PER 1,000 POP.
Worcester	22	160,897	195,000	825
Evansville	24	197,941	102,000	1,940
Sacramento	22	146,385	106,000	1,370
Tacoma	36	398,685	109,000	3,640
Nashville	25	175,092	167,000	1,050
Youngstown	37	295,390	168,000	1,760
Fort Wayne	20	135,644	118,000	1,150
Tulsa	42	159,678	142,000	1,120
Chattanooga	15	246,787	128,000	1,920
Knoxville	31	404,471	111,000	3,640
Flint	23	190,183	151,000	1,260
Des Moines	43	283,583	160,000	1,770
Salt Lake	40	506,620	150,000	3,370
Duluth	34	304,075	101,000	3,000
Richmond	27	291,598	193,000	1,510
Hartford	42	475,594	166,000	2,860
Elizabeth	22	231,392	110,000	2,120
Scranton	46	444,715	140,000	3,180
Norfolk	17	199,343	144,000	1,390
Trenton	8	136,790	125,000	1,090
Tampa	14	85,857	108,000	800
Jacksonville	11	90,824	174,000	535

Water is bled into such a reservoir during the night hours of low use and withdrawn by a booster pump at times of peak use. Let us take for illustration a city of 25,000 which normally would occupy 4 to 6 sq.mi. and assume that it had an average daily pumpage of $2\frac{1}{2}$ mgd. and, with no elevated storage, a peak rate of 6 mgd. Let it be assumed further that the pumping station is at one side of the city. A storage reservoir of 1-mil.gal. capacity would normally be adequate to enable the plant to operate at its average 24-hr. rate, the peak being supplied by a booster pump at the reservoir on

the far end of the system. One-half to three-fourths of the critical pressure drop would be corrected by this method. The cost of the reservoir installation would be approximately $35,000. To secure equal capacity would involve the construction of a main costing $55,000. Although the initial cost is also in favor of the reservoir, the small use of critical materials is its real advantage. It would require but 75 tons of critical materials for the reservoir, pump and motor (largely reinforcing bars) as compared to approximately 660 tons of cast iron for the pipe line.

These figures are based upon the conventional reinforced-concrete box type of reservoir. It would be practicable in most soils to build a reservoir in excavation, with the sloping banks paved with concrete and with a wood roof, requiring but about 20 tons of critical materials per million gallons of capacity.

Recently, in a city of 80,000, one district remote from the pumping station was inadequately served. To correct the deficiency by a new feeder main would have required 300 tons of pipe, valves and fittings. Instead, a 250,000-gal. reservoir, with a 1-mgd. gas engine pump, requiring but 20 tons of critical materials, was installed. The pump will operate less than 60 days per year and a maximum of 6 hr. per day.

In another city a defense demand averaging 250,000 gpd., but requiring water at a 1-mgd. rate, was located 3 mi. from the pumping station, with only an 8-in. line between. A 250,000-gal. concrete reservoir, built on a hill, using 20 tons of reinforcing steel accomplished the same results as would have been accomplished by 350 tons of cast iron in a duplicate main.

Pumping Heads

As an alternative means of increasing deliveries during peak demand periods, without adding feeder mains, it may be possible, in some cities using reciprocating equipment, to raise the station pumping pressure during peak periods during the emergency. If the station pressure is raised 21 per cent, that will increase the capacity of the distribution system approximately 10 per cent. Of course, this will increase the cost of operation and may result in some leaks on the water system and the consumers' premises, but, in general, this will be less inconvenient than the formerly almost universal practice of raising pressure for fires. Expenditures for fuel and power in the ordinary plant vary from 8 to 15 per cent of the total cost of operation. The overall effect on the fuel bill of increasing the capacity of the distribution system 10 per cent by raising the pumping pressure during peaks will be less than 1 per cent of the operating expenses. As this increased pressure will permit greater deliveries, increased sales and correspondingly increased revenue, the expedient may be justified as a temporary measure, even from the economic standpoint.

Transportation

L. A. Geupel (4), in a valuable paper on automobile operating expenses, cited numerous statistics on the use of automobiles. From his data Table 2 is abstracted. The average automobile use, as computed from this table, is shown to be about 900 car-miles for each mile of pipe in the system. It surely looks like a lot of miles!

It is going to be necessary to curtail drastically the operation of utility as well as private cars. In Table 2 the average of twenty-two cities showed a car operation of 1,870 mi. per 1,000 population. Eleven, or half, of the cities had mileages under 1,500 mi. per thousand population, but five, or nearly a fourth of the total number, exceeded 3,000 mi. per 1,000 population.

Another study, made in the writer's office, surveyed the use of cars in fourteen cities in the 200,000- to 500,000-population bracket, showing an average mileage of 1,120 mi. per 1,000 population served.

Much of this mileage will necessarily be reduced. It is believed that the average water department can cut its automobile mileage substantially in half. Many cities, including Cleveland, Portland, Detroit, Boston, St. Paul and Omaha, have averaged less than 500 mi. per year per mile of main, i.e., about half the average of the twenty-two cities from Mr. Geupel's study.

Some cities have already substituted bicycles for automobiles for collections, suburban meter readings, light repairs, turn-off and turn-on. One large company in the Chicago area has purchased 50 bicycles for its meter readers.

Services

In recent years copper tubing has been the principal water works service material. At the present time it is practically unavailable and probably will not be available for the duration. Lead, already under limited restrictions, will probably become increasingly difficult to obtain. A new lead alloy pipe, "Tubeloy," largely lead, but with sufficient strength from the alloy to permit its use in thin walls, is being tried out with varying degrees of satisfaction.

Steel pipe for services is available and will probably be most largely used during the emergency. Based upon the experiences of the natural gas industry, which uses steel pipe almost exclusively, and the writer's inspection of several thousand steel pipe lines, uncoated, bituminous-coated, and bituminous-coated and wrapped, it is the writer's belief that the service life of steel service pipe can be greatly lengthened by a coating and fabric binder. Inspection of large numbers of such pipe after several years in the

ground shows, upon removal of the coating, that the pipe carries the mill scale marks and is substantially as good as new. The binder effect of the wrapping is apparently important. Coating and wrapping should be particularly well done at threads and connections.

One superintendent states that, during the emergency, he is conserving his copper for use under paved streets, both repairs and new connections, and is using steel pipe elsewhere for services.

Joint Materials

With the present scarcity of rubber and jute for hub and spigot joints, attention is being given to the development of possible substitutes, among which it would seem that cotton, strawboard and fiber products might have some possibilities.

Material for Centrifugal Pump Impellers

Up to the present time most water works centrifugal pumps have been specified to have bronze impellers. With the more recently developed sewage pump designs and the handling of more gritty materials, the use of cast iron has largely supplanted bronze for impeller construction for that type of service.

With the improved quality of iron castings, it is now practicable to turn out impellers from cast iron, the equal of bronze in finish and efficiency. During the emergency it is believed that, since bronze is a more critical material than cast iron, specifications might well be written so as to substitute cast iron for the more usual bronze impeller for water works pumps.

Occasionally a centrifugal pump impeller, operating under high vacuum conditions, suffers from cavitation, which shows itself in the loss of material from the impeller vanes, sometimes to such an extent that the vanes are actually perforated. Recently the writer observed some water turbine wheels so badly eroded by cavitation that much of the runner was honeycombed. This was repaired by carbon arc welding, later ground down so as to restore the body of the runner and the original efficiency of the unit. An inspection of work on another turbine similarly repaired a couple of years earlier showed that the welded material withstood further cavitation as well as the original material.

Another method of metal repairs that has been much used lately is that of metalizing. This is a hot-spray process of building up metal sections, which is applicable to a wide variety of conditions. The Erie, Pa., water works has employed metalizing successfully for such widely varying uses as the building up of steel wash troughs which had entirely rusted through and the repair of piping on the zeolite boiler water softening installation. Erie operators report that metalized surfaces are more resistant to corrosion than

the original metal. Vance C. Lischer of the St. Louis County Water Co. has described (5) the use of metal spraying in the maintenance of centrifugal pump shafts, rings and impellers in that plant. Spraying with stainless steel is protection against later pitting and corrosion. Metalizing would appear to offer real possibilities, not only as an emergency material conservation method, but also in a wide variety of repairs in normal operations.

Conservation of Manpower

In this emergency, manpower is a critical material. Recently, William A. Irvin, former president of the U.S. Steel Corp., was quoted as stating that industrial accidents had last year deprived the United States of 460-000,000 man-days of labor. If only 20 per cent of this could be prevented it would affect our national economy $750,000,000 per year—sufficient to build 10 battleships of the North Carolina class, 2,100 Flying Fortresses or 6,600 heavy tanks.

Water works can co-operate by taking more rigid safety precautions, by extending their retirement age limits, by employing girls for men called to service, etc. One large private water company is employing the wives of employees in service, wherever practicable, thus contributing to the maintenance of the economic status of the employees' dependents and also simplifying the adjustment in personnel when the man returns.

It has been surprising to the writer to see how little the war has interfered with water works operations to date. The manufacturers of water works materials, equipment and supplies have done a wonderful job. But we are in a war—and it is a war of machinery and equipment as well as men. No industry, even one as important to urban life as water works, should ask for critical materials until it has accomplished everything possible through repair or rehabilitation of existing facilities. The construction thus deferred will conserve materials now and provide a backlog to relieve future slack production and unemployment.

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Organization and Training of Water Main Emergency Repair Crews and Auxiliary Personnel Assigned to Emergency Water Service Duties

THIS BULLETIN is designed to serve as a guide to local councils and local water officials in the organization, development and training of auxiliary or volunteer emergency water main repair crews and other auxiliary personnel assigned to emergency water service duties. An expanded outline of training courses is given in such a way that this bulletin can be used as a syllabus and training guide for the courses to be given auxiliary or volunteer water service personnel by the local water officials.

The matter of organizing and training a sufficient number of water main emergency repair crews in each municipality of the state is urgent if we are to be adequately prepared to meet any emergencies. Local councils and local water authorities are therefore to proceed with the organization and training of such crews and other needed reserve or auxiliary personnel in accordance with the suggestions and recommendations made in this bulletin. Zone and Assistant Zone Co-ordinators should be called upon to give assistance in the training program.

Integration in the Local Civilian Protection Organization

In all matters related to the field of civilian protection which includes the organization, development and training of water main emergency repair crews and other auxiliary personnel for emergency water service duties, the chairman of the local council is in general command. It is his duty to see that such crews and auxiliary personnel are organized and adequately trained but he will delegate to the local water officials the detailed responsibilities for their development, training, disposition, and assignment.

Water Series, Bulletin No. 1, prepared by the State Office of Civilian Protection, Division of Water Main Emergency Repairs—Earl Devendorf, Director and State Water Supply Co-ordinator—in co-operation with the Bureau of Public Service Training, State Department of Education.

The State Water Supply Co-ordinator acts as technical advisor to the State Director of Civilian Protection. Zone and Assistant Zone Water Supply Co-ordinators act as technical advisors to the State Deputy Directors of Civilian Protection, the chairmen of local councils, and local water officials on all matters related to water. In the field of civilian protection, involving as it does all of the arrangements for establishment of an emergency organization of the water department to effect water main repairs and meet other water service problems promptly in the event of an emergency, the entire Mutual Aid Water Plan administrative organization operates as a Division of Water Main Emergency Repairs under the State Director of Civilian Protection.

In a similar way at the local level the local water head or person in responsible charge of the water supply serves as technical advisor to the chairman of the local council on all water matters and is the directive authority of the local council in relation to all emergency water service matters. The local water official in an emergency will utilize regular water department personnel to perform and direct the functions of emergency repairs and maintenance. With reference to emergency repair of water mains and other emergency water service duties he will, on behalf of the local council, have such auxiliary or volunteer personnel as are necessary under the local circumstances enrolled and directed to these protective services by the local civilian mobilization representative. Standards for such enrollees as formulated by the State Water Supply Co-ordinator and issued to the State Director of Civilian Mobilization are given below.

It is the duty of the local water department head to formulate plans for the organization and training of all auxiliary or volunteer personnel who are to perform water service duties in the event of an emergency and to furnish copies thereof to Zone and Assistant Zone Water Supply Co-ordinators. It is also the duty of the local water department head to conduct or co-operate with other water superintendents in the county in conducting such training courses according to the course of instruction outlined in this bulletin.

In the larger communities all emergency utility services may be grouped under the general command of one individual member of the local council, in which case the local water department head will be his technical advisor and person responsible for preparation and execution of plans, organization, training and assignment. In smaller communities and in some other instances the local water department head may be appointed to serve as a member of the local council.

All correspondence and plans related to the field of civilian protection and dealing with the organization, development and training of water

main emergency repair crews, etc., shall be forwarded by the local water official through the chairman of the local council to the Zone Water Supply Co-ordinator and by the Zone Water Co-ordinator through the appropriate deputy state director of Civilian Protection to the State Water Supply Co-ordinator in the office of the State Director of Civilian Protection.

Responsibilities of Local Water Authorities

Local water officials are clearly responsible for the management and operation of public water supplies. These responsibilities are inherent and cannot be shifted from the water officials to anyone else. If a catastrophe occurs it will be the local water officials and no one else who will have to take the blame for shortcomings of any kind, irrespective of the attempts which may have been made to delegate responsibilities to others. These responsibilities therefore should be clearly recognized by local councils and freely assumed by water officials.

In relation to the whole field of protective services as applied to water supply operation and maintenance, emergency repairs, etc., the local water officials have the sole responsibilities and must make the decisions on all matters related to the supply of water in the community. They must assume the responsibilities for the work of all regular and auxiliary personnel assigned to emergency water service duties and must suffer no interference from other elements of the local civilian protection organization on matters that clearly fall within the scope of their responsibilities.

Clear recognition of these principles by both local councils and local water authorities will contribute to the most efficient functioning of the water department as a unit in the local civilian protection organization and to the kind of relationships which must be established to assure teamwork and fullest co-operation.

Liaison Between Control Centers and Water Department

In event of a serious bombing, the extent of the disruption of water service will be the primary factor governing the degree of the catastrophe. If water fails all else fails. Without water, fire departments will be unable to control fires and the catastrophe will run its natural course. The difference of a few minutes in closing valves to stop the loss of water at a break may mean all the difference in the world in diminishing the extent of the catastrophe.

It is therefore of utmost importance that adequate arrangements be set up in the control center of each community so that water officials will receive immediate reports of air raid alert signals and prompt reports of water incidents relayed to the control center by air raid wardens. It is important that water officials be notified of air raid warning signals, etc.,

as promptly as such warnings are made to fire officials. The water department must be appraised of all "yellow" air raid alert signals as well as "red" signals so that it can place all of its personnel in readiness for instant action in case an actual air raid occurs.

A representative of the water department should be in attendance at the control center at all times, responsible for the relaying of messages to the water official. In the control center there should be complete plans of all the water mains in the area (skeleton plans are good enough), with sizes and valve positions prominently marked, together with "key" firms, charts and names and addresses and telephone numbers of all personnel likely to be needed in an emergency, as well as similar data concerning the key men of other adjoining water authorities and their control services. The key firms should be informed if any incident occurs affecting their supplies. Standby messenger service should be available in case telephone lines are out of order.

Air raid wardens in making reports of water incidents should state the exact position of the incident, the time of origin, whether inside or outside of premises, other services affected, whether the break appears large or small, obstructions, and such other helpful information as it is possible for them to obtain quickly. These reports should be made to the control center as quickly as possible and be relayed immediately to the local responsible water official, whose duty it is to get one of his employees to the scene immediately to shut off valves to prevent loss of water, make an estimate of the repair jobs and arrange for repairs as speedily as possible.

It is the duty of local water officials to see that proper arrangements are worked out with local councils for their representation at control centers.

Recruitment of Auxiliary or Volunteer Personnel

For his emergency organization, to serve as foremen of water main emergency repair crews or in other key emergency capacities, the local water official should utilize such of his regular employees as are suitable and competent for the purpose. All volunteer personnel required by the local water department head to complete his emergency organization in accordance with the instructions contained in this bulletin should be enrolled with and assigned to water service duties by the local civilian mobilization representative. This includes all volunteer personnel previously enlisted directly by local water officials, if they are not now enrolled. To complete the records of the Volunteer Mobilization Branch the record cards of all personnel previously enlisted should be turned over to that branch for recording and filing.

Local water officials should therefore consult with the local civilian mobilization representative and arrange to have assigned to them such

volunteer personnel as are required for emergency water service duties under the particular local circumstances.

Qualifications of Volunteer Personnel

The State Water Supply Co-ordinator has notified the State Director of Civilian Mobilization that the following qualifications are required of all volunteer personnel enrolled for emergency water service duties:

1. *Foremen of Water Main Emergency Repair Crews*
   (a) Persons who are licensed to practice as master plumbers; or
   (b) Journeymen or apprentice plumbers who are recommended by their employers as competent to supervise water main repairs after some training and under supervision of the water superintendents; or
   (c) Persons with previous experience as steamfitters or in laying or repair of water, oil, gas, steam or other pipe lines; or
   (d) Other persons with qualifications acceptable to the local water superintendent. The local water service authority shall accept only such individuals to serve as foremen of water main emergency repair crews as in his opinion have the necessary qualifications.
2. *Members of Water Main Emergency Repair Crews*
   Robust physical condition, preferably with previous experience in ditching or excavation work, ability to handle heavy pipe and perform hard manual labor and handy with the pick, shovel and other ordinary tools.
3. *Turncocks or Valve Operators*
   Same general qualifications as for foremen of water main emergency crews. (Generally the foremen of water main repair crews would perform the function of shutting off water and making quick estimates of repair jobs following reports of broken water mains or other water incidents.)
4. *Supervisors of Emergency Water Delivery Service Organization*
   At least a high school graduate with some knowledge of chemistry and practical experience in the direction of a small group of workmen. Must be intelligent and have the ability to learn the fundamentals of handling water and disinfecting water and equipment after a short course of training.
5. *Operators of Temporary or Auxiliary Chlorination Plants*
   Persons with previous experience in operation of mechanical equipment such as pumps, motors, chemical feeders, refrigeration or other small machines. Must be sufficiently intelligent to master the fundamentals of water treatment after a short course of training.

Extent of Auxiliary or Volunteer Personnel Required

The State Water Supply Co-ordinator has established the following standards which are subject to increase if future experience indicates the need therefor. As a start local water departments in all communities should proceed to organize and train repair crews and other auxiliary water service workers in accordance with the following:

1. *Water Main Emergency Repair Crews*
   (a) Each crew shall consist of a foreman and six members, provided, however, that the local water official may increase or decrease the number of members of each crew as he may deem advisable.
   (b) Each crew shall be supplied or have access to the supplies, tools and equipment needed for repair jobs.
   (c) In communities *which are in or within 10 mi. of what are considered by the local councils to be likely target areas* the number of water main emergency crews which should be organized, trained, and developed are indicated in Table 1.
   (d) In communities *which are considered by local councils to be from 10 to 20 mi. from likely target areas* emergency water main repair crews in the ratio of at least 50 per cent of those indicated above should be organized and trained.
   (e) In communities *which are considered by local councils to be well removed from likely target areas* at least one such emergency repair crew should be organized and trained in each community under 5,000, at least two in communities between 5,000 and 20,000, and at least three in communities above 20,000.

The above rules relating to the number of emergency repair crews which should be organized and trained are based upon the principle that proceeding outward from the most likely target areas the need for such repair crews as applying to each particular area will diminish, but that in all areas, whether deemed subject to possible attack or not, there should be a sufficient number of repair crews to constitute a reserve for quick assignment to areas under attack where additional crews from outside areas undoubtedly will be needed.

Under the theory of mutual assistance the small isolated community which would be given prompt aid in the event of difficulties of any kind is obligated to make some contribution to the general cause. The organization and training of emergency repair crews at least to the extent indicated above affords one opportunity for the small communities to make a definite and valuable contribution not only in the interest of self protection but to the general plan of mutual assistance.

2. *Turncocks or Valve Operators.* Either the foreman of each emergency water main repair crew should serve in this capacity or valve operators should be organized and trained in the ratio of one to each emergency water main repair crew.

3. *Supervisors of Emergency Water Delivery Service Organization.* One such organization should be established and a supervisor appointed and trained in each community of the state regardless of size if the community is considered by the local council to be in or within 10 mi. of a likely target area. The extent of the organization will vary with the local circumstances but should be sufficient to handle adequately the emergency delivery of water to residents in the event of a complete water failure. Plans for such organization should be worked out by the local water officials in co-operation with the local health officer and the local council.

TABLE 1

Schedule of Repair Crews Necessary for Likely Target Areas

Municipalities Population Range	*No. of Emergency Repair Crews Needed*
less than 2,000	1
2,000- 5,000	2
5,000- 9,000	3
9,000- 14,000	4
14,000- 20,000	5
20,000- 28,000	6
28,000- 34,000	7
34,000- 42,000	8
42,000- 49,000	9
49,000- 75,000	10 to 12
75,000-100,000	12 to 15
100,000-200,000	15 to 24
200,000-300,000	24 to 32
300,000-400,000	32 to 40
400,000-500,000	40 to 48
500,000-600,000	48 to 54

4. *Operators of Temporary or Auxiliary Water Treatment Plants.* In each community three such operators should be appointed and trained for each emergency water supply which it is locally anticipated may have to be utilized by direct pumping into the system.

Training

The training courses for the auxiliaries should be administered by the local water department heads or superintendents utilizing the services of regular employees or others who are competent to give instruction on particular subjects. The content of the training program is suggested in the syllabus contained in this bulletin.

In the small isolated communities well removed from likely target areas where the auxiliaries to be trained may be limited to one or two persons the training course should be conducted largely by the conference method unless several communities combine to give a joint course, in which case the auxiliaries of several communities can be brought together for training in those subjects which have general application. On subjects which have strictly local application, however, each local water superintendent will have to give the instruction.

In general it is recommended that water officials in large cities conduct training courses exclusively for their own auxiliaries but that joint or combined courses be established to provide training for auxiliaries in the smaller cities, villages and town water districts. These joint or combined courses should be encouraged by County War Councils and organized on a county basis as far as possible. The suggested syllabus for the training program is based upon a class of from a half dozen to about thirty auxiliaries. It should be given to all auxiliaries who are to serve as foremen of water main emergency repair crews, turncocks or valve operators, supervisors of emergency water delivery services, or operators of emergency pumping stations and chlorination plants, with attendance required at class sessions by the various auxiliaries as indicated in the syllabus.

It is not contemplated that labor members of repair crews shall complete the entire course of instruction. They should be invited to attend any or all of the classes and required to attend those which have specific application to their emergency duties. They should be required to take part in all drills and field tests which upon completion of the course should be repeated from time to time to sustain interest and develop perfection in the emergency organization.

The training course for all auxiliaries in the classes mentioned above shall include 30 hr. of actual instruction, at least 20 hr. of which shall be classroom instruction. Up to 10 hr. of actual field drill or practice may be counted as part of the required total of 30 hr. of instruction.

It is recommended that 2-hr. classes be held twice each week until each auxiliary has completed 20 hr. of classroom work and that the classroom instruction then be followed as soon as possible by five 2-hr. periods of field work. However, it may prove more advantageous to alternate field lessons and class lessons.

Upon completion of the prescribed course of training the local water official shall certify the names of those whom he regards as having satisfactorily passed the course to the State Water Supply Co-ordinator through the Zone Co-ordinator. The State Water Supply Co-ordinator will certify all such names referred to him to the Bureau of Public Service Training of the State Education Department, which Bureau shall arrange

to issue Board of Regents certificates to those whose names have been so certified.

The local council shall arrange to issue or authorize the issuance of appropriate arm bands or other insignia as are approved by the State Director of Civilian Protection, to all auxiliary or volunteer personnel assigned to emergency water service duties upon recommendation of the local water official. It is important that all auxiliaries including labor members of repair crews be issued arm bands with approved insigne so that no difficulties will be encountered by them in reporting to their stations or performing their duties during air raid alarms or actual emergencies.

Instruction Methods

Each instructor should attempt to develop as much as possible the attitude of a school teacher in preparing for and in conducting the training classes. He should make the instruction formal to the extent of being well prepared for the lectures and demonstrations he is to give and the problems he is to solve, but informal to the extent that he will command the attention of his students and secure their free participation in discussion.

The classroom preferably should be a quiet room in a water plant, shop, or perhaps a local school with sufficient chairs and other furniture to make the students comfortable and give them the feeling that they are actually in school. A blackboard should be available and used frequently to illustrate particularly important points in the instruction. Visual instruction aids should be used wherever possible as they are particularly helpful in getting the instruction across to the student. Wherever actual demonstrations of making repairs, making ortho-tolidine tests, etc., can be made, they should be employed and the students given an opportunity to repeat the demonstrations themselves. Motion pictures to illustrate London air raids and other features of a blitzkreig, particularly if they relate to water, should be used. These are obtainable through the Bureau of Public Service Training, 40 Steuben Street, Albany, New York, without charge except as to shipping expense.

It is obvious that to maintain interest and attention in the classroom the local water superintendent who is to conduct the classroom session should be well prepared in advance of the lesson and know exactly what he is to cover and what he is to do. Otherwise instruction will lag and students will lose interest.

The suggested course offered herein is intended only as a guide and may be modified to suit local requirements as long as equivalent instruction on the subjects indicated is provided.

Teaching Hints for Training Water Department Auxiliaries

Step I—Preparation

A—*By the Water Department Instructor*

1. Determine what you are going to teach.
   a. Decide what material you are going to cover.
   b. Determine the principal points in each lesson.
   c. Arrange the material in the order in which you wish to cover it.
   d. Find out the principal points in your lesson involving
      (1) things auxiliaries must be able to do, such as disinfecting mains, repairing pipes, etc.
      (2) information which auxiliaries must be able to apply, such as ortho-tolidine tests, etc.
2. Plan each lesson.
   a. Keep on the track.
   b. Eliminate unrelated material which will only confuse the auxiliary.
   c. Build up the principal points logically.
   d. Plan in detail how you will
      (1) demonstrate the things the auxiliaries must be able to do.
      (2) teach the information which auxiliaries must be able to apply.
   e. Check your delivery and time yourself in a practice session before each lesson.
3. Set your stage.
   a. Have enough seats available.
   b. Have plenty of light and air in the classroom.
   c. Have a blackboard.
   d. Have motion picture and slide projection machines where possible.
   e. Have ready all tools and other pieces of equipment you may need.
   f. Have demonstration equipment and tools arranged in the order in which you will use them.

B—*Of the Auxiliary*

1. Put the auxiliary at his ease. Be friendly, but let auxiliaries know they are subject to department discipline.
2. Get the auxiliary interested in learning what you are going to teach him.
3. Point out how it will benefit him, his family and his friends to learn the information which you are going to present.

Step II—Presentation

A—*General Procedure*

1. Tell the auxiliary plainly and simply what the lesson covers.

2. Avoid the use of technical language wherever possible. Talk plainly and simply.
3. Dramatize the material by presenting stories from your own experience. Keep on the point with such stories.
4. Show the auxiliary the things about which you are talking.
5. Illustrate their use or importance.
6. Question the auxiliary to be sure he understands.

B—*Things to Keep in Mind*

1. Stress principal points. Do not take the punch out of your lesson by stressing equally both important and unimportant points.
2. Be clear and complete about each point. Do not take up more than one point at a time. Do not take up a new idea before the auxiliary understands the old one.
3. Continue to check the auxiliary's grasp of each point by asking questions. Repeat statements and demonstrations when necessary.
4. Convey to the auxiliary the importance of each new point you raise. For example, tell how failure to chlorinate may result in an epidemic.
5. Use moving pictures, slides, diagrams and drawings where possible. Be sure to explain clearly all important points.

Step III—Performance

A—When the auxiliary is learning how to do things, teach him by having him perform the job. Have him operate repair equipment, etc.

B—When the auxiliary is being given general or technical information, question him on his understanding of it. Ask the auxiliary to apply his new knowledge in an imaginary situation. Check carefully on the understanding shown by his answer.

Step IV—Checking

A—Carefully check the auxiliary's performance or statements.

B—Ask questions beginning with why, how, who, what, where and when.

C—Don't start new lesson material until you are sure the auxiliary has mastered the previous lesson.

D—At intervals review not only the previous lesson but all the preceding lessons.

Schedule and Description of Classes

Presented on the following pages is a schedule of the classroom and field lessons of the course. These lessons are also outlined in some detail below.

In each class or field period, lectures should be adjusted to allow for discussion periods, oral quizzes, etc.

SYLLABUS OF INSTRUCTION

(All Classes Are Planned for 2-Hour Periods)

Class Lesson	Subject	Attendance Required of	Combined or Separate Class
1	Organization and operation of local water department and the water supply	All auxiliaries	Separate
2	Relation of water to health	All auxiliaries	Combined
3	Relation of water supply to fire protection	All auxiliaries	Combined
4	Chlorination and tests for residual chlorine	All auxiliaries	Combined
5	Disinfection of water pipes, water handling equipment, tanks and reservoirs	All auxiliaries	Combined
6	General repair technics	All auxiliaries	Combined
7	Temporary repair of broken water lines	Foremen of repair crews. Attendance optional for others	Combined
8	Use and operation of repair equipment	Foremen of repair crews. Attendance optional for others	Separate
9	Location and operation of valves and fire hydrants	Foremen of repair crews. Attendance optional for others	Separate
10	Operation of chlorinators and handling of chlorine	Supervisors of emergency water delivery services and emergency pumping plant or treatment plant operators. Attendance optional for others	Combined
11	Operation of pumps	Supervisors of emergency water delivery services and emergency pumping plant or treatment plant operators. Attendance optional for others	Combined
12	Emergency sources of water supply	Supervisors of emergency water delivery services and emergency pumping plant or treatment plant operators. Attendance optional for others	Separate
13	Plans of action in case of emergencies	All auxiliaries	Separate

Field Lesson	Demonstration	Attendance Required of	Combined or Separate Class
1	Operation of a fire pumper	All auxiliaries	Combined
2	Inspection of a water purification plant	All auxiliaries	Combined
3	Inspection and operation of local repair and maintenance equipment	All auxiliaries	Separate
4	Practice in chlorine demand and residual chlorine tests and batch disinfection of water.	Supervisors of emergency water delivery services and emergency pumping station and treatment plant operators. Attendance optional for others	Combined
5	Practice in making repairs or operating repair equipment	Foremen of repair crews	Separate
6	Drill under simulated emergency conditions	All auxiliaries	Separate

It is suggested that at the last class lesson a brief examination of the "true-false" type be given to all auxiliaries, the questions being adapted for the type of service the various auxiliaries are to perform.

The outline of class and field lessons should prove helpful to instructors in developing the course of instruction. It is not intended to be complete since local water superintendents and others who are to serve as instructors are expected to exercise ingenuity in planning the course to fit the local needs and circumstances. Variations in the course content, inclusion of additional subjects and rearrangement of the order of lessons should be made if this seems desirable in the judgment of those responsible for conducting the courses.

Field Lesson 6 should not be regarded as the final lesson of the course except in relation to obtaining certificates of completion. Field Lesson 6 should be repeated from time to time under different, simulated emergency conditions to give auxiliaries the practice which they need and to develop perfection in the emergency organization and plans for action. In such drills there should to the fullest possible extent be actual assembly and transportation of material and equipment to the point of need, and thorough discussion of the simulated problems and how they are to be handled. Laborers assigned to repair crews should participate in all field drills.

Class Lesson 1

Subject: Organization and operation of the local water department and water supply.

Instructor: Each local water department head should give this lesson separately to his own auxiliaries.

Scope: First Hour—Lecture covering history and development of local water supply, organization of water department, rules and regulations in effect, description of supply with explanation of the functions of various elements, etc. Use map of water system, pertinent charts and blackboard sketches to illustrate particular features.

Scope: Second Hour—Discussion period and oral quiz followed by demonstration of how to solve simple arithmetical problems involving ratios, percentages, calculation of volumes of water in pipes, reservoirs, excavations, etc. Problems should be selected which will be typical of those likely to be encountered in making repair estimates, etc.

Assign for study, prior to Lesson 2, pages 161 to 175 of Bulletin No. 22 of New York State Department of Health entitled "Water Supply Control." This assignment relates to conversion factors and the arithmetic of water treatment.

Class Lesson 2

Subject: Relation of water to health.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. An outstanding water works expert, a health officer who has particular knowledge of such matters, or a district engineer of the state department of health should serve as instructor.

Scope: First Hour—Lecture on general aspects of the subjects: water-borne diseases and modes of transmission, germ theory of disease, contamination of water lines through cross-connections, repairs and back siphonage, and related matters. Outline the history of some outstanding water-borne outbreak. For source material refer to numerous articles in the A.W.W.A. JOURNAL, technical magazines, or Rosenau's *Preventive Medicine*. Use prepared charts or blackboard sketches to illustrate particular features.

Scope: Second Hour—Discussion period and oral quiz followed by demonstration of the use of conversion factors and how to calculate dosages to obtain chlorine solutions of various strengths and solve related problems.

Assign for reading prior to Lesson 2 some articles appearing in current technical literature relating to bombings or emergency water problems during air raids.

Class Lesson 3

Subject: Relation of water supply to fire protection.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. An outstanding water works expert, fire chief, or engineer who has good knowledge of water supply fire requirements should serve as instructor.

Scope: First Hour—Lecture on general aspects of the subject, flow requirements for various types of fires, situations with respect to water supply which will exist in case of multiple fires, differences in situations with respect to water supply which will result from demolition and incendiary bombings, explanation of demolition and incendiary bombs and related matters. Use prepared charts or blackboard sketches to illustrate particular features and display models of bombs if obtainable.

Scope: Second Hour—Discussion period and oral quiz followed by showing of motion picture "London Air Raid" or other similar motion picture obtainable upon request through A. H. Hall, Director of the Bureau of Public Service Training, State Education Department, 40 Steuben Street, Albany, New York.

Assign for reading prior to Lesson 4, pages 77 to 100 of Bulletin No. 22 ("Water Supply Control") and Bulletin No. 33 ("Tests for Residual Chlorine and Ammonia") published by the State Department of Health.

Class Lesson 4

Subject: Chlorination and tests for residual chlorine.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. An outstanding water treatment plant operator or superintendent should serve as instructor.

Scope: First Hour—Lecture on the purposes and theory of the chlorination process, chlorine demand, chlorinator equipment of various types, and both the starch iodide and ortho-tolidine tests for residual chlorine. Use prepared charts or blackboard sketches to illustrate particular features.

Scope: Second Hour—Discussion period, oral quiz and demonstration of chlorine demand test, starch iodide and ortho-tolidine tests.

Assign for reading prior to Lesson 5, New York State Department of Health mimeographed bulletin entitled "Manual of Emergency Sanitation Services."

Class Lesson 5

Subject: Disinfection of water pipes, water handling equipment, tanks, reservoirs, etc.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. An outstanding water works superintendent or a district engineer of the state department of health should serve as instructor.

Scope: First Hour—Lecture on principles and methods of disinfecting pipes utilizing both portable chlorination equipment and powdered hypochlorites, and the flushing and testing of water before service is resumed. Describe methods and dosages for disinfecting reservoirs and tanks, and related matters. Use prepared charts or blackboard sketches to illustrate particular features.

Scope: Second Hour—Discussion period, oral quiz and demonstration of the batch disinfection of water in cans or tanks. Use bottles set up in laboratory with varying organic content. Demonstration should include calculations of amount of chlorine to be added and residual chlorine tests.

Assign for reading prior to Lesson 6 some articles from recent water works literature relating to repair of water mains or tapping water pipes.

Class Lesson 6

Subject: General repair technics.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. Some employee of a water department who is expert in making repairs, taps, joints, laying pipe, etc., should serve as instructor.

Scope: First Hour—Lecture on different types of equipment used in repair work, leak detector, hoists, tapping machines, wet cut or other cutting machines, solid sleeves, split sleeves, flexible couplings, methods of tapping, jointing, installation of corporation cocks, methods of sheeting, and related matters.

Scope: Second Hour—Demonstration of methods using actual equipment set up in shop or some suitable location.

Assign for reading prior to Lesson 7 some article from current technical literature relating to emergency repairs of broken water lines.

Class Lesson 7

Subject: Temporary repair of broken water pipes.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages in the county. An outstanding superintendent experienced in repair operations and familiar with technical literature on the subject should serve as instructor.

Scope: First Hour—Lecture on the detailed methods of making repairs in a bomb crater where both water and sewer lines have been broken. Lecture should describe the methods of making temporary connection between fire hydrants through hose line, method of de-watering crater and effecting temporary repairs to sewer line followed by method of making water repairs through bridging of crater or by-passing of crater using either new lengths of pipe or sleeves. Procedure for disinfecting the repaired line, testing, etc., before restoration of water service should be included. Use prepared charts, blackboard sketches or demonstration set-ups to illustrate methods.

Scope: Second Hour—Discussion, outline of the solution of additional problems, and oral quiz.

Assign for reading prior to Lesson 8 some article from current technical literature relating to water main repair methods.

Class Lesson 8

Subject: Use and operation of repair equipment.

Instructor: Each local water superintendent who maintains sufficient repair equipment should give this lesson separately to his own auxiliaries. Otherwise the instruction should be given to a combined group with some other superintendent who has various types of repair equipment serving as instructor.

Scope: Two Hours—Under direction of the instructor give each student practice in the operation of all equipment such as leak detectors, tapping machines, chain hoists, paving breakers, compressors, etc.

Prior to Lesson 9 provide each foreman with a map of distributing system

and accurate record of valve locations. (To be treated confidentially by foremen of repair crews.)

Class Lesson 9

Subject: Location and operation of valves and fire hydrants.

Instructor: Each local water department head should give this lesson separately to his own foremen.

Scope: First Hour—Explanation of the location and characteristics of all valves and hydrants over the system. Explanation of the operation and manipulation of a valve and fire hydrant.

Scope: Second Hour—Demonstration of the flushing of a fire hydrant, the opening and closing of valves, etc. Illustrate by charts or diagrams the effect of water hammer. Discussion and oral quiz.

Prior to Lesson 10 assign for reading by each supervisor of emergency water delivery service or emergency pumping or chlorination plant operators some article from water works literature relating to the precautions which should be taken in handling chlorine.

Class Lesson 10

Subject: Operation of chlorinators and handling of chlorine.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages of the county. An outstanding water superintendent or representative of a chlorination equipment manufacturer should serve as instructor.

Scope: First Hour—Lecture on care and operation of various types of equipment, various types of installations, precautions in handling chlorine, storage of cylinders, and related matters. Use actual equipment or diagram to illustrate apparatus.

Scope: Second Hour—Demonstration of the disassembly, cleaning and reassembly of a chlorinator, method of connecting a chlorine cylinder, and use of gas mask.

Assign for reading prior to Lesson 11 some articles from water works literature or a water works textbook which explains the operation of various types of pumps.

Class Lesson 11

Subject: Operation of pumps.

Instructor: Instruction preferably should be given to a combined group of auxiliaries from all towns and villages of the county. A water works superintendent having good knowledge of the care and operation of pumps should serve as instructor.

Scope: First Hour—Lecture on the operation of various types of pumps—centrifugal, piston, portable, etc. Discuss suction lift suction and discharge heads, capacities, etc. Discuss lubrication, care and maintenance. Use charts or blackboard sketches to illustrate principles of operation.

Scope: Second Hour—Demonstration of operation of a water works pumping station, Venturi meters, recording equipment, switchboard, etc.

Prior to Lessons 12 and 13 each local water superintendent should have available for distribution to his auxiliaries a well conceived plan for action to be taken by the auxiliaries in event of air raid alarms or actual emergencies. The instructions should include directions as to where and to whom each auxiliary is to report and what his duties will be under various simulated conditions. The plan should include also a list of all emergency water supplies which may be used and the exact arrangements outlined for their use.

Class Lesson 12

Subject: Emergency sources of water supply.

Instructor: Each local water department head should give this lesson separately to his own auxiliaries.

Scope: Two-hour field inspection of all emergency water supplies which it may be necessary to use with directions in the field as to the hookup which will be required in the event of their use.

Class Lesson 13

Subject: Plans of action in case of emergency.

Instructor: Each local water department head should give this lesson separately to all of his own auxiliaries.

Scope: First Hour—Lecture and explanation of the plans which have been formulated for emergency action.

Scope: Second Hour—Discussion and "true-false" examination based on all lessons of the course.

Field Lesson 1

Subject: Operation of a fire pumper.

Instructor: Demonstration preferably should be made to a combined group of auxiliaries from all villages and towns of the county. A local fire chief should be asked to provide the demonstration.

Scope: Two-hour demonstration of the hookup of a fire pumper, explanation of its operation, and demonstration of fire streams. General method of operation of the fire department should also be explained.

Field Lesson 2

Subject: Inspection of a water purification plant.

Instructor: Superintendent of the plant. Should be made by a combined group of auxiliaries.

Scope: Two-hour tour of inspection with explanation of processes and operation by the superintendent.

Field Lesson 3

Subject: Inspection and operation of repair and maintenance equipment.

Instructor: Each water department head should conduct his own auxiliaries on tour of inspection.

Scope: Two-hour inspection of all repair tools and other equipment with instruction as to their use, withdrawal from storerooms, etc. Operation of equipment should be demonstrated and auxiliaries given some practice.

Field Lesson 4

Subject: Practice in chlorine demand, residual chlorine tests, and batch disinfection of water.

Instructor: Demonstration should be for a combined group of auxiliaries. An experienced water plant operator or chemist should serve as instructor.

Scope: Two hours' practice by each student in making the various tests.

Field Lesson 5

Subject: Practice in making repairs or operation of repair equipment.

Instructor: Each water department head should provide practice periods for his own auxiliaries.

Scope: Two hours' practice in performing various repair operations in a shop or on a demonstration setup.

Field Lesson 6

Subject: Drill under simulated conditions of an emergency.

Instructor: Each local water department head should provide drill periods for his auxiliaries.

Scope: Two hours' drill under a simulated emergency. Drill should include the receipt of reports of water incidents, simulated shut-off of water in the affected sections, assembly on the job of repair equipment which will be needed for repairs, discussion of how the job is to be done, estimate of time required to complete it, review of the set-ups for emergency pumping stations and chlorination plants, water delivery service, etc. From time to time this field lesson should be repeated under different simulated conditions.

Sequence of Events in Event of Actual Bombing Attack

In order to help water officials visualize what they may be called upon to face provided an actual air raid occurs at night and damage to the water system results, the following imaginary sequence has been set up:

1. Yellow warning signal received by local control center from district warning center.
2. Water superintendent is alerted and calls key men to station.
3. Air raid siren sounds and other water department employees go to predetermined point or stay at home awaiting call.
4. The air raid.
5. Bomb damages water main.
6. Control center is advised of damage by police, air raid wardens or others.
7. Control center notifies water department headquarters.
8. Water department headquarters orders crew to shut off damaged main.
9. Shut-off crew cuts off water main.
10. Shut-off crew notifies department headquarters, using preferential telephone, that work of shutting off has been completed.
11. Water department headquarters notifies control center and, through them, the fire department, that main is out of service.
12. Superintendent or foreman inspects site of bombing.
13. Plans are made and crews organized for performing the necessary repair work.
14. If repair work appears to be beyond ability of local department to cope with, the Zone Co-ordinator is called on for aid.
15. Repair work is started at daylight unless the main damaged is one that cannot be kept out of service or unless blackout is over before morning.

In arranging drill periods (Field Lesson 6), the plans should be developed to synchronize activities along the lines of the anticipated sequence of events.

Following completion of the above course of instruction the auxiliaries should be brought together from time to time and given supplementary information concerning emergency problems, etc. In this connection planned meetings at which motion pictures illustrative of emergency water problems and duties would be shown will do much to sustain interest of the auxiliaries in their work and emergency assignments.

Wartime Control of Public Utilities

By A. E. K. Bunnell

BRIEFLY stated, the purpose of price control is to halt the vicious and disastrous cycle of inflation due to increased purchasing power and a decrease in the available supply of goods and services. The purpose of supply control, on the other hand, is to insure the most efficient and equitable use of available goods and services, e.g., power, transportation and telephone services. It is toward the accomplishment of these two purposes that the Government of Canada has organized the various inter-related boards, committees, etc., which constitute its control authority.

The cost of living index, which, in August 1939, just prior to the outbreak of war, was 100.9, had, by October 1941, advanced to 115.5. That control measures have been justified is evidenced by the fact that the index for February 1942 was only 0.2 point higher than it was in October 1941. In other words, whereas in the 26 months without control it had risen an average of 0.56 point per month, in the four months under control for which figures are now available it has risen an average of but 0.05 point per month.

Experience with supply scarcity is perhaps better known to water works men. The effectiveness of control in this respect is more difficult to evaluate, but that control is necessary is obvious.

In Canada, the primary control authority set up to cope with these problems is the War Measures Act. Under it, the Parliament and/or the Government of Canada, represented by the Cabinet, has almost unlimited powers to conscript manpower and the production of goods and services and, in general, to control all men and all things, regardless of peacetime rights and privileges. In pursuance of these powers, the Government has, for the control of civilian rights and privileges, established certain administrative bodies, one of which—the Wartime Prices and Trade Board—the author proposes to discuss in detail.

The Wartime Prices and Trade Board at present consists of eleven members, under the chairmanship of Donald Gordon, Deputy Governor of the

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Bank of Canada. Through board representation, liaison is maintained with the Wartime Industries Control Board, the National War Labor Board, the Export Control Committee, the Commodity Prices Stabilization Corporation and other bodies. The chairman of the Wartime Industries Control Board is a member of the Wartime Prices and Trade Board and each of the controllers, e.g., the Power, the Oil, the Transit and the Transport Controllers, are *pro tem* members of the Board. When actions affecting their various fields are under discussion, all price decisions involved are subject to the approval of the Board, the result being that responsibility for all matters pertaining to prices of civilian goods or services rests upon it. Within the last three months, the Board has extended its jurisdiction to include control of highway transport and telephone services.

With the approval of the Government-in-Council, the Wartime Prices and Trade Board has appointed administrators to act on its behalf and has set up Regional Prices and Supply Representatives across Canada, to whom the public may make representation with respect to alleged infractions of the regulations and upon whom the administrators may call for assistance in ascertaining the true facts of any particular situation.

Authority of the Board

Immediately following the outbreak of war, the Government of Canada by Order-in-Council P.C. 2516, on September 1, 1939, constituted the Wartime Prices and Trade Board, the Wartime Prices and Trade Board Regulations being made and established to provide wartime safeguards against any undue enhancement in the prices of food, fuel and other necessities of life and to ensure an adequate supply and equitable distribution of such commodities.

From time to time, the powers of the Board were extended and the Regulations amended and consolidated. On November 1, 1941, Orders-in-Council Nos. 8527 and 8528, respectively, consolidated and established the Maximum Prices Regulations and the Wartime Prices and Trade Regulations as they exist at present.

The Maximum Prices Regulations provided, among other things, that no person (the term is used in its most inclusive sense and includes all utilities regardless of by whom they are owned or operated) should on or after December 1, 1941, without the expressed consent of the Board or the particular administrator concerned, charge more for equivalent goods or services than was charged during the basic period named in the regulations, viz., the four-week period, September 15 to October 11, 1941, inclusive, subject to the maintenance of any differentials customarily and lawfully allowed to any class of customer.

The Wartime Prices and Trade Regulations provided, among other things, that the Board has the power to:

1. Fix prices and prescribe the terms and conditions under which such goods or services may be sold
2. Investigate cost, price, inventory, supply and transportation of any of the goods and services set out therein
3. Prescribe the kinds, qualities and quantities of any such goods or services
4. Require any person having possession or control of any such goods or services to deal with, dispose of, or supply such goods or services in such manner as may be specified by the Board.
5. Require any person to perform such acts in respect to any goods or services as is deemed by the Board to be desirable.

Further, with respect to these powers, it is expressly provided that the powers of the Board (with the exception of the power to fix prices) should not be exercised in the control of any goods or services with respect to which a controller representing the Department of Munitions and Supply has been given authority, except at the request or with the concurrence of the Chairman of the Wartime Industries Control Board.

It will be evident, accordingly, that the powers of the Board are broad and far-reaching. Services are specified to include, among other things:

1. The supplying of electricity, gas, steam heat and water
2. Telegraph, wireless and telephone services
3. Transportation of goods and persons and the provision of dock, harbor and air facilities
4. Warehousing and storage.

With respect to services, the Board has delegated its power to an Administrator of Services, James Stewart, Assistant General Manager of the Canadian Bank of Commerce, located in Toronto. His powers, however, are always subject to a right of appeal to the Board by any person.

Application of Price Control

The policy of the Board in connection with all public utility rates is that control will continue to be exercised through existing dominion, provincial or municipal commissions, etc. In other words, whenever an authority is already established to approve rates, it is not the intention of the Board to supersede or override the jurisdiction of such authorities, except insofar as any rates proposed to be established appear to contravene the provisions of the Maximum Prices Regulations. In connection therewith, the board has been able from time to time to formulate certain general principles under which the great majority of the cases which now come before these authorities are disposed of in the ordinary way without reference to the Services Administration.

Without exception, the utility boards across Canada are giving the administration their wholehearted support. The two principal railways, the Bell Telephone Co., the British Columbia Telephone Co., all of which operate under federal charter, and water-borne traffic, insofar as it applies to package freight, are under the control of the Board of Transport Commissioners for Canada. Lake rates on grain are under the control of the Board of Grain Commissions for Canada. Otherwise, without exception, control of service and rates, when exercised, lies with the provincial or municipal authorities.

In very few of the provinces do the utility commissions have control over municipally owned utilities, except when they give service outside their own municipality. Exceptions to this general rule are found in the powers of the Board of Commissioners of Public Utilities of Nova Scotia, and in the Public Utilities Board of the Province of British Columbia.

Where errors in billing or failure to bill have arisen through an oversight on the part of a public utility or non-disclosure, on the part of any user of its service, of facts, which if known to the utility, would have resulted in the application of the appropriate rate, the utility may correct the error and thereafter charge the lawful rate and in so doing will not in any particular be violating the provisions of the Maximum Prices Regulations. In this connection the Board has been required to handle a considerable number of inquiries from persons who, for one reason or another, have moved into a higher price class with respect to electric and telephone service.

Rate Increases

Except under special circumstances where it is obviously evident that a particular rate is grossly unfair to the other users of the service, the Board is unwilling to consent to any change in the rates which would impose increased rates on any class of customer merely for the purpose of adjusting an unbalanced rate structure which had been operating for some time. On the other hand, if the revenues of the utility are insufficient for its continued support, the Board would be willing to consider an increase in the rates, requiring, as a part of any such application, that the applicant furnish a balance sheet of the utility for the calendar years ending December 31, 1939, 1940 and 1941, a profit and loss statement, with details of revenues and expenditures for the corresponding years, a schedule of both the present and proposed rates, the number of customers and the extent to which each class of customer would be affected.

It has been necessary for the Board to advise several utilities that the introduction of a rate schedule which raises bills to some customers and lowers them to others would be an infraction of the regulations and as such

could not be permitted. In some cases utilities have been able to modify their proposed new rate structures in such a way that, in the main, such inequalities were removed, keeping the new structures within both letter and spirit of the regulations. As an alternative, the Board has permitted the introduction of new schedules on the guarantee of the utility that, so long as the Maximum Prices Regulations are in effect, no single customer will be charged more during a current billing period than would have been charged for equivalent service under the rate structure existing during the basic period. Under either of these plans the individual customer has no cause for complaint and the utilities are making a valuable contribution to the work of the Board.

With respect to municipally owned utilities, the Board has been unwilling to concur in an increase in rates, even though the utility has been operating at a loss. Usually it has been found that such a condition has existed for some years. In such cases, where the price to the users of the service has been too low, the Board has held that correcting the condition and transferring the burden from the taxpayer to the user of the service must be postponed for the duration. On the other hand, in special cases, where a municipally owned utility is operating at a loss and is serving only a small group of the taxpayers and where, accordingly, it would be difficult and unfair to charge the deficit in revenue against the general taxpayer, the Board has concurred in an increase of the rate structure.

In cases where one company or municipality is operating two or more utilities, for instance an electric light and water service, and where one is being operated at a loss, but an overall profit has been shown consistently, the Board has refused to concur in an increase, even though it may not be proper from one point of view to charge users of one utility with the deficit incurred by the other utility operated by the same company.

The Board's position is that the Maximum Prices Regulations are freezing orders designed, among other things, to freeze utility rates at the levels existing during the basic period, unless maintenance of such rates will result in the discontinuance of an essential service. Inequalities which existed in a rate structure prior to and during the basic period must be left aside in any such consideration. In such cases the Board's inability to concur in rate increase does not imply in any way that, under normal circumstances, the increases requested would not be justified nor does it imply any disagreement on the part of the Board with the general principle that each user of service from a utility should pay a rate which is equitable with regard to rates charged to other users of the service and that, where the same company operates two separate utilities, the customers of one such utility should not be called upon to bear the burden for customers of the other utility by reason of the fact that the rates of the latter are inadequate.

Application of Supply Control

By reason of the acute shortage of rubber, oil and automotive equipment, and with the approval of the Chairman of the Wartime Industries Control Board, the Wartime Prices and Trade Board, on March 10, 1942, through the Services Administration took over the regulation and control of the transportation of goods by means of automotive transport vehicles.

Similarly because of the shortage of materials required for telephone plant and facilities, the Administrator of Services has been given control (effective on April 8, 1942) of all telephone services. In connection with this latter, however, certain priorities of use have been established and the refusal to supply or continue service will rest with the telephone companies, subject to the right of appeal to the Administrator of Services.

The regulations of supply that are included in these cases affect utilities (other than telephone companies) only incidentally, and they are mentioned merely to indicate that, when the necessity arises, control will be exercised.

Unusual Features in Rate Structures

With respect to the digging of underground services for water or gas utilities, it has been the practice of some utilities, when frost is in the ground, to accept or refuse applications for service connection at their own option, and to accept them only subject to the payment by the applicant of the actual cost, over and above normal summer rates. In such circumstances the Board has granted concurrence on the guarantee of the utility that the winter charges will not be in excess of those charged for comparable installations of the winter of 1940–41, and that the utility will revert to the summer rates at the usual time and that such rates will not be in excess of those charged during the basic period.

A utility located in the United States was supplying gas to an adjacent Canadian town. Under the special circumstances it was beyond the power of any Canadian authority to compel it to render service in Canada under conditions repugnant to it. Accordingly, the Board has no option but to concur in an increase in the rates to be charged to its Canadian customers.

In some cases water rate structures which are based in whole or in part on the percentage of the assessed value of the premises served have come to the attention of the Board. In these cases, it has been ruled that the right of the utility to charge the appropriate rate, even though it may mean an increase, is not affected by the Maximum Prices Regulations.

Wartime Procurement Problems of Canadian Utilities

By M. J. McHenry

WHEN the present war was launched in September 1939, few of us fully realized either the magnitude which it would assume or the demands which it would place on our economic system. Subsequent events have brought home to us a realization that our resources must be strained to the limit, if victory is to be attained.

Somewhat vaguely we knew that our enemies were making preparation for total war, but only recently has it become completely apparent that our production of the tools of modern warfare must be adapted to produce, in one-third of the time, more than these enemies have accumulated over many years of concentrated and intense effort. Such a position has called for an unprecedented expansion of industry to produce war equipment, munitions, ships and the tools and power to manufacture them. This shifting from peace to war has presented major problems to all industry; and, to the utilities, these problems are both serious and numerous.

Many people fail to realize that there is a scarcity of raw materials and but few are aware of the reasons for such a shortage. Canada has always considered itself well supplied with natural resources and, in the case of many materials, this is true; but modern warfare requires added use of many materials not obtained here, and these must be imported. The importation of such materials is now extremely critical, either because of lack of shipping facilities or because of the temporary war successes of our enemies.

In the case of Canadian natural resources, it must be remembered that the limiting feature is not the supply of ores, but the ability to refine these ores and manufacture the resulting metals in a form suitable for supply to the fabricating industry. Smelters, steel producing plants, and power plants all require time to plan and construct, and their expansion places an added strain on manufacturing groups already crowded to the limit.

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Expansion, therefore, is limited both by the time factor and by the inability to withdraw scarce materials from essential civilian and war uses for such purpose.

Relative Scarcity of Materials

During the last four months, the economic position of the United Nations has suffered severely because of the immediate (and temporary) victories of Japan. Previous to these, the collapse of France and the invasion of other European countries by Germany had unfavorably affected the economic position of Canada. It is illuminating to note the relative economic position of the combatant groups, between the fall of 1938, and the present year. An indication of the percentage control of world production of some important items by the United Nations in 1938 and at present is given in the following tabulation:

Commodity	*1938*	*1942*	*Commodity*	*1938*	*1942*
Wheat	86.5%	65.5%	Iron ore	92.7%	55.4%
Sugar	82.3	56.3	Manganese ore	90.0	65.0
Butter and margarine	76.0	50.6	Lead ore	91.6	78.0
Wool	96.8	88.0	Zinc ore	85.0	71.5
Cement	66.3	48.4	Tin ore	90.6	26.8
Coal	68.0	54.6	Bauxite	74.8	34.2
Steel	75.3	56.9	Rubber	100.0	8.9

These figures indicate the drop which has resulted from the conquests of our enemies and point to the fact that in many cases, such as rubber and tin, our supplies of raw materials have, for the time being, almost disappeared.

All metals are not equally scarce, and the ability to obtain metals varies in degree, for different reasons. In some cases, either the metal itself or the ore from which it is refined must be imported, and its supply is therefore subject to the state of shipping facilities and to the effect of other markets. In other cases, the supply is limited by the capacity of the producing mills, as well as by the demands of allied nations. At the present time the relative scarcity of various essential metals (from scarcest to least scarce) is indicated by the order of the following list: vanadium, tin, tungsten, molybdenum, aluminum, nickel, steel, copper, zinc, brass, chromium, manganese, cadmium and lead. Vanadium and tin are, of course, very scarce, and metals such as lead, at the bottom of the list, are much more readily available.

Such a situation necessitates drastic action, on the part of governmental authorities, in the allocation of the use of all of these materials, and the reservation of those quantities which are necessary for the production of war equipment. Such a program of allocation and priority must seriously

restrict all civilian and non-essential uses, and presents to the utility numerous problems in procuring the materials which it requires for both expansion and maintenance.

Reliance Upon U.S. Materials

In the production of both mechanical and electrical equipment, the manufacturer in Canada is to a greater or lesser degree dependent upon the United States for certain material and parts to be incorporated in the equipment which he is building. In some cases, certain equipment is not built in Canada, and must be procured by importation. For this reason, the utilities of Canada find it imperative to operate under both the Canadian and United States systems of priorities. It is not possible, in a few words, to describe the workings of these allocation and priority systems. The essential difference that has existed up to the present time between the systems worked out in Canada and the United States is that the U.S. system has employed formal published priority rating, while the Canadian method has been to avoid a formal rating system and to depend to a large extent on a system of allocation of material. Neither of these has been wholly successful, and the indications of the moment are that they are tending to coalesce into a system which combines the better features of each.

Since December 1941, when the United States came into the war, the difficulty of procuring material and parts from that country has been greatly increased. The reason is readily apparent when it is remembered that in the last three months the United States has increased its own war program from a total of 64 billion dollars to a total of 137 billion dollars, or more than double. As a result, material and equipment which had previously been available on ratings of A-10, A-8 and A-5, are no longer procurable under ratings lower than A-2. To complicate the situation further, most manufacturers in Canada are now working under the Production Requirements Plan (P.R.P.) of the United States War Production Board, which necessitates that they must have some rating which will enable them to classify their orders in making their quarterly report to the War Production Board. Therefore, they are now demanding of Canadian utilities and business generally, a rating with all orders.

At the present time, the utility has only one means of obtaining a United States priority certificate and rating. This is under the application form known as PD-1A, the use of which imposes very considerable routine and paper work on the part of the utility and, at the same time, delays the procurement of the ordered equipment. It is necessary for this application to be forwarded to Ottawa, and thence to Washington, requiring an average of three weeks before the rating to be applied on the order is issued. It

is then necessary for the utility to extend this rating to its supplier by endorsement on its purchase order.

In the United States, utilities have been operating for some time under the P-46 utility order, which provides a blanket rating of A-10 for the procurement of all equipment and material required for operation, maintenance and essential repairs. Recently, this rating has been raised to A-5 for most items, and, in the case of pumping equipment, to A-2. The United States has not, as yet, however, permitted the extension of the P-46 order to utilities in Canada. This is now under consideration, and will probably be extended in the near future.

If this happens, Canadian utilities will be able to make application through Ottawa, to use the P-46 order and to extend this rating to their suppliers, both U.S. and Canadian, with their purchase orders. It is possible, however, that on June 30 this year, the United States will discontinue the P-46 order for utilities, and place all utilities on the Production Requirements Plan now being used largely by industry. This would result in much the same operation as would be obtained under P-46 order, and will have, in addition, the advantage of making it possible to obtain certain equipment for essential capital expansion, as well as that required for maintenance and operation.

Canadian Procurement Controls

Insofar as the Canadian requirements are concerned, the utility system must conform to regulations of the various controllers with regard to its supply of necessities. If a projected expansion of the utility system is to involve an expenditure of more than $5,000, it is required that a construction permit be applied for and received from the Controller of Construction before such work may proceed. If steel is required to carry out the construction work, permission of the Steel Controller must also be obtained. In the case of many utilities which are large users of non-ferrous metals, particularly copper, brass and bronze, definite limitations have been set forth by orders of the Metals Controller, which require a release to be obtained before purchasing equipment or material, or even before using such material when it is in stock. All of these regulations must be complied with, and failure to do so leaves the utilities subject to the penalties imposed by the Wartime Industries Control Board. Such regulatory actions are necessary to enable the various controllers to distribute properly the limited supply of materials to the maximum advantage of the war program of Canada.

As indicated previously, it is not possible to present a detailed picture of the operation of these controls. Suffice it to say that the restrictions and regulations for the control of materials have imposed on the industry

greatly increased work in the purchasing and procuring of their equipment and materials and the added factors of substitution, restriction of non-essential expansion and prevention of hoarding.

The normal and orderly process of purchasing material and equipment is no longer possible. The utility is faced with the procurement of construction licenses, Metal Controller's releases, Steel Controller's releases and priority ratings for imports from the United States. All of these must be attended to—in many cases before the order can be placed, and in all cases before any material will be shipped. This interposes a new time factor in the procurement of supplies. It calls for a greater anticipation of essential requirements to compensate for the additional time required in obtaining them, so that the delivery date will not extend beyond scheduled requirements.

Restriction of Non-Essential Expansion

From the utility standpoint, the present situation does not permit of further expansion of non-essential uses, particularly in the fields of domestic, rural or ordinary commercial services. It is particularly true in those cases, where such expansions would require large quantities of scarce materials and equipment requiring scarce metals. The use of such equipment must be restricted to provide the maximum of service for war industry. In other words, the only utility system expansion which can be considered essential today is that required for war industry, or to provide for essential civilian needs relating to food, clothing and health.

Probably one of the most interesting problems presented to the utility engineer is the question of substitution of less scarce materials for those which are very scarce. This is particularly noticeable in the case of rubber and tin. Engineers must exercise every bit of ingenuity they possess in the replacement, where possible, of such scarce materials with other materials which are more easily obtainable. For example, bearing metals which do not contain tin are now procurable and, apparently, are giving satisfactory service. Where rubber has been used for insulation, other materials must now be considered, and their application studied.

Substitution is not solely confined to the use of different materials; it also has an application in the problem of design. Existing conditions do not warrant design which is directed at improved appearance or rigid adherence to maximum standards of high safety factor. For the time being, these factors should give way to the demands for utility only. The designing of equipment and plants, during the emergency, requires that the main consideration be the use of that equipment and material which is most readily procurable and the use of the minimum quantities which will serve the immediate need. Such procedure can be followed, with the idea of returning to maximum standards when the war is over.

Not alone in the field of substitution of materials and design is the engineer faced with a problem. In the field of operation and maintenance, he must make every effort to retain the utility system in satisfactory operating condition with the minimum of new material and equipment, restricting maintenance projects only to those which are essential for safety and continuity of operation. Projects which would normally be undertaken to provide the highest standards of service must now be subordinated to the greater necessity of conservation. Where reasonable operation can be obtained, without making changes, these should be postponed till after the war.

Reduction of Inventory and Manpower

The salvaging of used material is an important feature of present day operation, and many utilities are now paying strict attention to their salvage problems. Every item of equipment which is taken out of service must be carefully scrutinized, and, if at all possible, rehabilitated and made use of in other locations. If examination demonstrates that it is no longer useable, it should be scrapped immediately so that the metal will be returned, through the smelters and mills, to the market as quickly as possible.

It seems a natural characteristic of human nature to accumulate supplies of material which are hard to get and to hold these for possible use in the future. Such action, today referred to as hoarding, is by no means helpful in the present situation. The holding of considerable stocks of material in excess of what is considered a reasonable requirement for emergencies, defeats the purpose of the control and allocation of material required by industry. At present, the various controlling authorities of Canada are working toward a re-allocation of existing stock, to prevent the hoarding, by any organization, of any stock greater than that which may be considered essential for 30 days' or three months' operation, as conditions may dictate. Here again, the utility is confronted with the advisability of anticipating such governmental requirements, by making excess stock available for immediate use within its own organization, or by outside organizations. It would seem that such voluntary action in reducing excess stocks is preferable to action by compulsion; but if it is not carried out, it may result in confiscation of excess materials by federal authorities.

The accumulation of scrap metal and the failure to keep this moving into processing plants holds back the supply of the finished product. Today's requirements call for the saving of all scrap and the continuous feeding of this scrap into the processing manufacturers' plants through authorized dealers. Manufacturers and utilities must appreciate the fact that scrap metal is valuable and that a great part of its value lies in its prompt conversion into production materials, rather than in lying around storage yards in large quantities.

An added wartime problem of the industry is that of manpower. For the job in hand, there is a shortage of technical and trained personnel. The requirements of the military forces have accented this shortage, with the result that many utilities find it necessary to operate with a greater percentage of partially trained technicians. In many cases, it is necessary to institute training classes and courses in an endeavor to make up losses to military requirements.

Summary

In this paper, an attempt has been made to indicate the reasons why materials are scarce and hard to obtain and to point out the major problems that result from this scarcity. The chief problems presented are the restriction of non-essential expansion, substitution both in design and material, reduction of stock, and the salvaging and handling of scrap material and manpower.

In conclusion, it should again be stressed that the utilities of Canada play a very important part in Canada's war program. Therefore, the challenge is placed before Canada's engineers to assist in solving these problems. In most cases, they can be solved only with technical knowledge and ability. Every engineer should accept this challenge, and endeavor to play his part, whether great or small, in their solution. This is a contribution to a victorious war effort which should ever be foremost in our thoughts and endeavors.

Relation of County Health Department to Local Water Supplies

By Arthur H. Herberger

NASSAU County is located on Long Island and extends eastward about 16 mi. from the boundary of New York City to the Suffolk County line. Its population of 435,000 is scattered over the 275 sq.mi. between Long Island Sound and the Atlantic Ocean.

In 1938, a new county charter authorized the organization of a county health department. This department has been developed on the sound, but only recently practiced, theory that public health engineering work should be done by qualified engineering personnel and that all activities in environmental sanitation should be under engineering direction. Prior to the formation of the department, there existed some 68 local health jurisdictions, none of which employed an engineer. Engineering personnel of the Nassau County Department of Health now numbers three, with an additional engineering position shortly to be filled.

Every health department has many and varied duties, but a new department has infinitely more problems than does an established organization. Hence, at first, only the most critical and the most requested tasks were given attention. It was believed that the natural purification properties of the Long Island sand, which underlies a large portion of the county, and the absence of any history of outbreaks of intestinal disturbances definitely traceable to water, as well as the excellent bacteriological results of sampling, left little to fear of the public water supplies. For this reason, although it was not entirely neglected, the water problem was definitely slighted during the early days of the department's existence.

The first casual acquaintance with a number of water supplies was made in the summer of 1939, when inspections of swimming pools revealed that, of 28 public pools, 27 were being operated in violation of the State Sanitary Code, by reason of cross- and inter-connections. This discovery, of course, promoted the department's interest in water supplies, to the extent that it was deemed necessary to pay more attention to their control. The

A paper presented on April 30, 1942, at the New York Section Meeting, Niagara Falls, N. Y., by Arthur H. Herberger, Asst. San. Engr., Nassau County Dept. of Health, Mineola, N. Y.

Director of the Division of Sanitation of the department believed that it would be of benefit to all concerned if an organization of Nassau water superintendents, similar to that of the Long Island Section of the New York State Sewage Works Association, could be formed. Letters were sent to all water superintendents in Nassau County and the first meeting was held on December 18, 1939. The groundwork for an organization was laid and the problem of cross-connections was discussed briefly at this session.

At about this same time, the sanitary engineer of the Suffolk County Department of Health had a similar plan for Suffolk County superintendents. Subsequently, both organizations joined into what is now the Nassau-Suffolk Water Superintendents Conference, an informal and unattached society. A number of meetings have been held, with as many as 70 persons in attendance.

Defense Preparations

During the summer of 1940 it was realized that this country would, sooner or later, become involved in the war and that time was of the essence in securing all data available on the county public water supplies. At that time, it must be confessed, little was known regarding the various systems. The state health department had given the county its files on public water supplies, but the information was general, obsolete and incomplete. No information, for instance, was available on distribution systems having dependent supplies, i.e., those purchasing water from another supplier.

The first step, therefore, was to formulate a detailed questionnaire that would give a complete and comprehensive picture of the water supplies. These data were secured in personal interviews with the water superintendents. Frequently, however, it was necessary to confer with the various consulting engineers to determine tank elevations, the datum for given elevations, or for maps of the distribution system. In this way the department anticipated the Governor's Mutual Aid Plan for Water Service in Case of Emergencies* by many months, and had at hand the distribution maps and the basic data necessary to plan the most advantageous emergency connections.

The terminology, "emergency connections," should be noted. A vast amount of time and energy has been spent in instilling, in the minds of the water superintendents and of the general public, the fact that cross- and inter-connections are undesirable and a menace to health, yet, now, many use these terms to describe desirable connections between two supplies.

* For description of the plan, see: DAPPERT, ANSELMO F. New York State Mutual Aid Plan for Water Service in Case of Emergencies. Jour. A.W.W.A., **34**: 189 (1942).

The terms are perhaps descriptive, but there is sufficient confusion between them at present without adding an additional meaning. Why not reserve the terms, "cross- and inter-connections," for those connections which should be avoided or eliminated, and substitute some such term as "emergency connections" or "inter-system connections" for those which are being recommended as part of the mutual aid plan.

The department's survey indicated that, prior to the mutual aid plan, there existed 38 emergency connections between supplies and four between districts having no independent supply. The latter were connections to an additional source of water not ordinarily used.

The first step in determining possible additional emergency connections was the preparation of a large map of the county, plotting thereon, from the distribution maps, the exact area actually served by the mains of each system. This map made apparent the locations where the systems adjoined or came closest to each other, so that the study of the detailed distribution maps of each system could be focused on these areas. The next step, then, was simply a matter of comparing pipe sizes in each system with distances between the mains and, from the comparison, determining the most advantageous connections. By this method 73 connections were planned, 46 of which were less than 100 ft. in length, many requiring only 10 ft. of pipe; 17, less than 500 ft.; 5 less than 1,000 ft.; and 5 over 1,000 ft.

Consideration was given to topographic and hydraulic conditions where they had a determining influence. Where hydraulic conditions were such that one supply could furnish water to another, but could receive little or none in return, and where that supply was not adequately protected by other sources of water, a connection, consisting of two hydrants, spaced 30 ft. apart, with a gate valve between, was suggested. This arrangement permits a gravity flow from the higher- to the lower-pressure system, and, by closing the valve and using a fire engine pumper, the delivery of water from the lower system to the higher.

For ordinary connections it was suggested that one gate valve be used. If desired, each supply could place an easily broken seal on this valve, the idea being that, in an emergency, no one would question the value of the water used and that the omission of meters would reduce both cost and interference with the flow of water. If necessary, the parties can join in a contract providing for an impartial board of arbitration to determine the volume used in an emergency.

Initiation of Mutual Aid Plan

Under the mutual aid plan and by appointment of Governor Lehman, the Nassau County Mutual Aid Co-ordinator is the Commissioner of Public Works, and the Assistant Co-ordinator is the Director of the Division of Sanitation of the Department of Health.

The health department made available to the office of the co-ordinator all the data secured by its questionnaire, all maps of the distribution systems, the detailed list of proposed emergency connections and a schedule of meetings between water supply officials, so arranged as to limit the number of conferences of each water supply to two. The Department of Public Works then drew up rough sketches of the locations of the proposed connections and called the necessary conferences, all of which have now been completed. In the course of these conferences, 64 (88 per cent) of the proposed connections were mutually agreed upon by the authorities of adjoining supplies.

A few parties objected to physical connections between supplies, offering as an alternate plan the laying of hose lines, when necessary. The health department objected vigorously to this solution, as being impractical. Friction losses in hose lines are high and fire engines might be used to pump sewage and water from craters caused by bombings, thereby contaminating the pumps and hose. Hose lines, too, are vulnerable to sabotage, and lines laid across roads must be protected from traffic. Likewise, it may be assumed that, in an emergency, all fire engines will be needed for fire fighting or temporary bridging, by hose, of important water lines severed by bombs. On the other hand, a physical connection requires only the turning of a valve and, in an emergency, the simpler the operation, the more likely its use as planned. Even in locations where two hydrants are recommended, the physical connection is also requested, since the water can flow one way by gravity, and, if no pumps are available, at least a portion of the higher system can be supplied in most instances. It must also be pointed out that a fire supply is not the only objective of the mutual aid plan. Domestic supplies for drinking and sanitary purposes are also essential, and, although under certain conditions a connection may be practically useless for fire supply, it might sustain limited domestic service.

To date only six of the proposed emergency connections have been made. Most superintendents are keenly interested in making the connections, but financial problems are delaying construction. The Nassau-Suffolk Water Superintendents Conference has served a useful purpose in uniting its members in the opinion that the prevailing charges and restrictions on pavement openings on county roads were excessive. Recognizing the urgency of the situation, the Department of Public Works has undertaken to absorb all costs for the repaving of county roads as may be required in the construction of emergency connections. After three months of delay, a second barrier has finally been lifted by an act of the legislature, permitting villages and districts to spend money on such connections made outside their corporate limits.

Many superintendents have expressed the hope that proposed emergency connections may be made mandatory, realizing that if the connections are

made, and no immediate need occurs, they may be accused of squandering the taxpayers' money; whereas, on the other hand, if such emergency connections are not made, they may be accused of criminal negligence if confronted by an emergency. Furthermore, with the present priorities situation, a water supply receiving an official order to install a specific connection could more readily obtain the materials necessary.

Many phases of water supply, other than emergency connections, relate to defense. In general, these have not been corrected, or even studied, in Nassau County. Some supplies have no valve books; others have failed to bring all valves to grade; some have inadequate supplies; and others have no auxiliary power. More important is the fact that no comprehensive county-wide study of electric supply to water plants has yet been made.

TABLE 1

Wells of Public Water Supplies in Nassau County

DEPTH	NUMBER	TOTAL CAPACITY	AVERAGE CAPACITY
ft.		*gpm.*	*gpm.*
28–50	99	6,908	70
50–100	25	7,628	300
100–300	133	34,994	260
300–730	66	55,560	840
730–1,300	7	5,440	775
Total	330	110,530*	335

* 160 mgd.

General Data on Nassau County Supplies

Many of the interesting studies of the data collected by the health department cannot, of course, be given, but perhaps some information of a general nature regarding the water supply of Nassau County will be of interest. Of the area of the county, 77.5 per cent is covered by 42 public water systems, of which 30 have their own sources of water. All water is secured from wells which are operated by suction, air lift or deep well pumps. A summary of the number and capacity of wells, grouped according to depths, is given in Table 1.

In connection with the source of water supply, it is interesting to note that sewage from approximately 325,000 (75 per cent) of the population is returned to the ground via private sewage disposal facilities and large adsorption beds of inland municipal sewage treatment plants.

Of the 30 village, district and company systems having supplies, 13 engage private laboratories for bacteriological and chemical analyses of the water. The frequency of bacteriological sampling varies from semi-

annually to weekly, and of chemical analyses, from semi-annually for the system to monthly on each well.

Bacteriological analyses are made quarterly by the state health department upon samples submitted by the public water supply superintendents. A compilation of the 37°C. counts for the 121 samples analyzed in 1941 is shown in Table 2. Only one 10-ml. portion of the 121 samples was positive for *Esch. coli.*

TABLE 2

Standard Plate Count Frequencies of Samples in 1941

35–37°C. COUNT	NUMBER OF SAMPLES	PERCENTAGE OF TOTAL
1	63	52
10 or less	96	79
20 or less	102	84
50 or less	108	89
100 or less	112	92
300 or less	117	97
1,000 or less	119	98
3,000 or less	120	99
10,000 or less	121	100

TABLE 3

*Compilation of Chemical Analyses of Public Water Supplies in Nassau County**

TEST	AVERAGE	MINIMUM	MAXIMUM
Hardness, *ppm*	38	3	96
pH value	5.4	4.8	6.8
Carbon dioxide, *ppm*	32	3.3	48
Chlorides, *ppm*	7.0	0.12	27
Iron, *ppm*	0.16	0.0	5.2
Alkalinity, *ppm*	12.3	2	35
Ammonia (Free), *ppm*	0.012	0.000	0.600
Ammonia (Albuminoid), *ppm*	0.013	0.000	0.600
Nitrites, *ppm*	0.038	0.000	0.800
Nitrates, *ppm*	1.6	0.000	12.2

* 30 wells.

A composite of chemical analyses and maximum and minimum values, Table 3, gives an indication of the composition of Nassau water supplies. Three supplies operate filter plants for iron removal. Seven supplies add various combinations of lime, sodium hexametaphosphate and soda ash to bring the pH up to between 7.2 and 9.3. Many systems use aeration to liberate carbon dioxide; a few use chlorine or chloramine as a safety factor.

Control Over Supplies

Water supplies in Nassau County are under the direct and indirect control of many agencies. The Water Power and Control Commission of the State Conservation Department is primarily interested in the conservation of water. The Public Service Commission has jurisdiction over the finances of the private water companies. The New York Fire Insurance Rating Organization is concerned with quantity and dependability of supply. The function of a division of the Nassau County Department of Public Works is to study water pumpage, ground water levels, etc., and to plan and operate county water supplies, when and if they are established.

When the health department undertook its proper function of public health engineering supervision of water supply, some people were outspoken in questioning the right of a health department to be interested in any aspect of water supply other than purity. This strange attitude was not anticipated and was somewhat difficult to understand. The department found itself defending what its engineers had assumed to be axiomatic, i.e., that a safe and adequate water supply is a paramount interest and concern of a health department and that concern for quality and quantity cannot be divorced from consideration of the structures supplying the water.

In some states all plans for new water plants and distribution systems or for the reconstruction or alteration of existing facilities and systems must be approved by the state health department. In New York State, however, plans need not be submitted or approved, in contrast to enforcement of such requirements for sewerage systems, sewage treatment plants, milk plants and swimming pools. Perhaps this procedure of the state health department offers some explanation for the aforementioned opposition to the county health department's interest in water supplies. The submission and approval of plans is usually one of the conditions under which an operating permit is issued. Water supplies, however, are not operated under a health permit, as are sewage treatment plants, etc.

As a result of this situation, the department's survey discovered supplies for which no distribution map had been prepared, and, in other instances, distribution system extensions which had been made without plans or engineering advice. Even chemical treatment may be started or changed at will without being brought to the attention, directly or indirectly, of the health department.

Although the United States Public Health Service standards for bacteriological, chemical and physical qualifications are generally accepted as the requirements for a water supply, there is no state law so stating or providing any other definite legal requirements or definition of a potable

supply. Rules and regulations for the protection of water supplies from contamination *may* be formulated by the state health department, but are not required for each supply. Where an additional source of water is desired, however, such rules and regulations are usually necessary to fulfill the permit requirements of the Water Supply and Control Commission of the State Conservation Department. In more than one case, where rules and regulations have been enacted and conformance reports submitted yearly to the state health department, no copy of the rules and regulations could be produced by local officials, who were also without any definite idea as to the provisions of such regulations.

A usual specification in the rules and regulations is that no private sewage disposal ground absorption systems be located within a certain distance of the wells. Hence, it is the opinion of the county health department that the water supply should have ownership of an area surrounding the wells, at least equivalent to that set forth in the rules and regulations, whereon the construction of private sewage disposal systems is prohibited. If this is not done, as has been true in many past instances, it is an injustice and an apparent infringement of the property rights of the adjacent property owners, since the restriction remains unknown until an attempt is made to build, and continues to exist until a public sewer becomes available. Such "extra" property acquired by the water supply might be permitted to be sold, with restrictions, when a sewer is constructed.

The State Sanitary Code likewise provides for no direct control over "private" supplies, other than in industries. In Nassau County, many restaurants have private water supplies, which in some instances serve thousands of patrons. Other small privately owned supplies serve from 30 to 50 bungalows; some serve groups of office buildings, factories, apartment houses and private dwellings. These supplies have not been subjected to sampling or any public health supervision and the majority of the consumers were unaware that they were drinking water over which there was no supervision or inspection. Recent discovery of the open casings of some of these wells makes one question the assumption that no surface supplies are used in Nassau County.

A year ago the department requested that all public supplies make an examination of their systems and submit a report, showing the name, location and type of premises where private water supplies were being used, regardless of whether or not these were connected to the public system. Many supplies have made excellent and thorough checks of their systems, and have either eliminated all cross-connections or required that the private supplies be examined four times a year. This quarterly sampling schedule of private supplies has been set arbitrarily by the county health department to conform to the quarterly state sampling schedule on public supplies.

Pursuant to the state public health law and the county charter, the Board of Health in 1938 enacted regulations known as the Nassau County Public Health Ordinance to supplement the State Sanitary Code and to deal with specific local problems. As all regulations of any value must frequently be changed, this ordinance was generally amended in September 1941. The section on private water supplies was revised to provide that all private supplies used for drinking and domestic purposes by any person, other than the owner, must be potable, protected against pollution and free from bacterial contamination, in accordance with the prevailing bacterial standards of water quality of the United States Public Health Service. Furthermore, such supplies in any eating place, place of public assemblage or institution, or in any factory or mercantile establishment employing ten or more persons, or to serve three or more dwellings not occupied by the owner, or employees thereof, were required to submit to the Nassau County Department of Health a quarterly bacteriological analysis made by an approved laboratory.

This regulation provides a definite basis for public health engineering supervision of private supplies and its enforcement is now under way. Wherever sources of pollution are so located as to make the safety of the supply doubtful, a sanitary chemical analysis is also being required, so that nitrogen contents may be used as a supplementary index of pollution. In many instances, where a public supply is available, this burden of examination may stimulate a connection to the public supply.

Previously, it was embarrassing to require a small restaurant having a private supply, with a permanent cross-connection to a public supply, to make water analyses in accordance with the State Sanitary Code, particularly when the owner might know that a large establishment nearby, serving many times the number of patrons, used a private supply only, and without supervision.

Questions as to the frequency of sampling and of whether or not the use of a small unapproved laboratory would satisfy the requirements of the State Sanitary Code were raised by some water supplies, especially from the legal standpoint, if an outbreak of illness should occur and be traceable to a private supply, presumably connected in accordance with the State Sanitary Code. Naturally a county ordinance is subordinate to a state code, but, if such an outbreak occurred, it is believed that a frequency of sampling identical with that of public supplies, and the use of laboratories approved by the State Department of Health, would be sufficient compliance with the State Sanitary Code to relieve responsibility, provided a sanitary survey showed no apparent reason to question the private supply. As to the ability of clinical laboratories to make water analyses, it is sufficient to illustrate their inadequacy by the recent example of one such

laboratory which made a telephone inquiry to the department, asking what media should be used in running a water sample. On further questioning, it was learned that the laboratory technician had never heard of *Standard Methods*! It is also being required that either the water superintendent or the approved laboratory collect the samples. One case was found where the owner was boiling the private water sample to insure satisfactory results.

Cross-Connections

The State Sanitary Code places the full burden of responsibility for cross-connections upon the public water supply officials. It has been found that many private water supply owners have merely disconnected a pipe when notified of a cross-connection. Although this is not satisfactory, it meets all the legal requirements of the code. Some of these owners have thereafter reconnected the supplies, again making the public water supply an unwitting violator. The public health ordinance therefore provides that no one shall make or maintain a cross-connection, as defined by the State Sanitary Code. As a violation of the public health ordinance is a misdemeanor (under Sec. 1740 of the Penal Law), the person who reconnects may be prosecuted. This does not reduce the responsibility of the public water supply, but provides a basis for action against the private party benefiting from a reconnection.

When the county health department began its work of eliminating cross-connections, attention was first directed at those connections considered most dangerous, i.e., in the sewage treatment plants. Almost without exception, dangerous connections were found in each plant visited, but, upon closer study of the State Sanitary Code, these public water supply priming lines to the discharge side of sewage pumps, etc., were found to be, not cross-connections, but inter-connections, the latter being prohibited in swimming pools, but not in sewage treatment plants.

The public health ordinance now prohibits the making or maintenance of any direct physical connection between a public water supply or approved private supply and a sewer pipe, or pipe, or device which may contain sewage under pressure. Thus, the most objectionable inter-connections are made illegal. A few plumbing codes within the county prohibit such connections from being *made*, but some of these codes do not prohibit the maintenance of connections previously installed. Three plumbing codes within the county are now known to prohibit all inter-connections in new installations, including submerged fixtures, unless provided with approved vacuum breakers.

At the present time it is believed more urgent than ever, to require that every effort be made to eliminate cross-connections and the more dangerous

inter-connections, since bombings, with resulting decreases in pressure in the public supplies, may be anticipated. Where unknown, but nevertheless contaminated, private supplies are prevented from entering the distribution system by a valve that really works, it is conceivable that someone may deliberately open the valve in an unwise effort to be helpful in an emergency by supplying needed water to the immediate community.

Some officials have assumed that only a few or no cross-connections existed within their systems, and, in these cases, it has been necessary for the health department to locate such connections by spot surveys to show the need for a detailed investigation. A tremendous amount of work remains to be done in the elimination of cross-connections and the enforcement of sampling requirements on private supplies in Nassau County.

Experiences and Problems Encountered

Public supplies have presented many interesting, although not original, problems. Difficulties have been experienced with stubborn jute and hemp contamination, which persisted after repetition of chlorine doses of 100 ppm. and a week's contact time. Some superintendents were unaware that the State Sanitary Code required all new mains to be disinfected before being placed in use, and others conveniently forgot this requirement.

One unique problem of deep well pumps, which could occur in many places, was encountered. A system was being studied for possible sources of contamination in an effort to explain some bad samples. It was found that the well was ordinarily run to waste to expel sand before being pumped into the system. The waste water was piped to a leaching basin which had an overflow outlet above the waste water discharge pipe. The bottom of this basin was clogged with leaves, thereby permitting poor seepage. During the investigation, the power was cut off while the well was being pumped to waste. The drop of the column of water in the well pipe created a suction that siphoned back into the well part of the contents of the basin. This well is normally pumped to the storage tank. Should a power failure occur, however, water in the pump discharge line would be prevented from going back into the well by a check valve. Therefore, if the valve to the waste line leaked, the basin water would satisfy the vacuum. This could also happen when the pump normally cuts out, unless the basin had drained down below the pump waste water pipe.

Open well casings, sumps instead of curbings around wells, shallow horizontal suction lines, abandoned wells in or near well fields presently used, open storage tanks, etc., are but some of the minor problems of the health department that must still be corrected in a few public water supply systems of Nassau County.

The lack of a county laboratory has greatly hampered the department.

Each year a number of unsolved intestinal disturbances occur among small groups of people throughout the county. Water samples are collected and found negative by routine *Esch. coli* tests and specific tests for suspected pathogenic bacteria. A laboratory within the county would permit a more detailed investigation of all these cases in an effort to determine their source, be it water, food, or milk. It would be especially advantageous during the present emergency to supplement the state quarterly sampling schedule of public supplies and to make a routine chemical analysis on each batch of chemicals used in treatment plants.

Although presented in a somewhat critical form, the problems discussed here must be recognized, if any solution is to be attempted. Nassau County is in a "tough spot," being adjacent to New York City, and being the home of some large defense industries. The urgent needs are for a more thorough study of the public water supplies and distribution systems, and the correction of their weaknesses. When power plants are not functioning, water plants operated by electricity and without auxiliary power are as useless as emergency connections that exist on paper only. It is hoped that it will not be a case of spending and doing too little, too late.

Discussion by *Charles R. Cox:** The comprehensive discussion by Mr. Herberger illustrates the fundamental relationship between basic public health laws and regulations, and the character of control of public water supplies by health departments. Experience in New York State has indicated that the slow process of education is preferable to the rigid and sometimes arbitrary enforcement of laws, because in this way are created favorable human relationships which are more important to proper operation of public water supplies than the existence of water works structures which legally meet the requirements of the public health law. For this reason the very general Article V of the Public Health Law of New York State has not been amended materially to include detailed requirements. It appears, however, that the favorable relationship which has been developed heretofore between local water supply officials and health officials of the state has paved the way for more extensive laws and regulations which will not be considered arbitrary and bureaucratic but which will be viewed as guides to satisfactory practice. Consideration, therefore, is being given at present to amending the State Sanitary Code pertaining to public water supplies.

There are no official standards of quality for potable water in New York State, except insofar as the federal standards apply to water supplies serving interstate carriers. This is not an inherent weakness, however,

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because the quality of potable water must be appraised in a very broad manner by consideration of many factors of an intangible and non-quantitative character.

The statement in the paper that major changes in public water supplies, including treatment, may occur without knowledge of the State Department of Health is misleading, inasmuch as Regulation 1 of Chapter V of the State Sanitary Code definitely requires that any changes affecting the sanitary quality of a water supply must be brought to the attention of the local health officer and the State Department of Health prior to making such changes. This regulation has applied primarily to the development of emergency sources of water supply and to emergency changes in treatment.

The rules and regulations enacted under the provisions of Article V of the Public Health Law are enacted generally when a request is received by the Commissioner of Health from the local water supply officials. Such requests are usually received from officials in charge of surface water supplies where conditions on watersheds are beyond the jurisdiction of the officials. Approximately 215 supplies are so protected in New York State, but relatively few supplies on Long Island are protected by rules because these supplies are secured from wells. It is obviously better to have complete control of a well supply through ownership of the surrounding land than to use the indirect method of control provided by water rules. Such rules must be published in the local paper on at least two occasions and a copy must be filed with the county clerk before they take effect. In addition, the local water supply officials must have copies of the rules available to serve on possible violators so that provisions are made to inform private property owners concerned as to the provisions of the rules. Obviously these provisions may not be effectively observed by some local water supply officials.

Mr. Herberger's discussion serves a useful purpose in focusing attention upon the administrative problems in the supervision of public water supplies by county and state health departments.

Relation Between the Water Plant Superintendent and the Accountant

By Otto K. Jensen

SUPERINTENDENTS and accountants in both privately and municipally owned water utilities have the same duties to perform. In the one, legal limitations regarding methods of procedure may be more strict than in the other, but their aim is the same—to operate the utility to the best advantage, giving the service demanded by the public at the least possible cost and keeping the operating properties at the highest point of efficiency. Since the author's experience has been with the Indiana Department of Inspection and Supervision of Public Offices (the state board of accounts), which has supervision over the accounting of the municipally owned water utilities of the state, this paper will be confined to a discussion of the problem as it relates to municipally owned plants, particularly from the viewpoint of an accountant; but, because of the similarity of purpose, most of the remarks will, no doubt, hold true for private utilities as well.

Two officials—the superintendent and the accountant—are primarily responsible for the achievement of the purpose of the utility. The need for a superintendent, capable of operating the plant efficiently and keeping the physical properties in good condition, is well recognized; but there is a tendency to disregard or underestimate the value of an accountant, capable of keeping records in such manner that the statements of operations and finances taken therefrom present a true picture.

It is sometimes felt that the only purpose of an accounting system is to show that cash has been placed in a bank and that the cash balance is sufficient to cover a purchase which must be made. In such cases, the only records kept are those necessary for making required reports to some outside agency, and those by the shortest method and with the least effort possible. In making audits, the author sometimes gets the impression

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from utility officials that their records are kept merely for the auditor's examination and that that is their sole use and value. By such officials, accounting is considered a necessary evil. In most such cases, however, it is forgotten that the reports required are nothing more than a summary of the records, and that proper accounting of the operations is a picture of the business to which detail is added from day to day and month to month, until at the end of the period a complete picture can be placed before the board of control.

Comparative figures are essential to determine trends in all phases of business. Such items as water pumped, water used, sales, costs of pumping and delivery of water, accounts unpaid and delinquent, status of cash, special funds and reserves must be subjected to close control. The location of a leak in a water main may be determined by an instrument devised and constructed for that purpose, but it is just as important to prevent leaks or weaknesses in the administrative operations of the plant. These can be detected only by proper accounting. Proper records are merely the instrument for that purpose and the accountant, the operator of the instrument.

Often, the utility is the largest business in a community. Its capital investment is large and there is every reason why it should be protected by proper accounting methods. This fact is becoming increasingly apparent to water works officials and it is becoming more and more important that a water works have a good accounting system. It follows that more emphasis should be placed on accounting experience by those charged with the operation of the utilities.

State Accounting Control in Indiana

In 1933, the Indiana General Assembly placed the accounting of all municipally owned utilities under the supervision of the Department of Inspection and Supervision of Public Offices. Up to that time, little attention had been paid to utility accounting procedures except as they affected the control of cash through city or town treasuries.

Through special examinations of the utilities made under the new authorization, the true state of affairs was learned. The general state of neglect was almost unbelievable. It was revealed that some well operated properties had been getting by with such poor accounting systems that even the simplest operating statements could not be drawn from their records. Superintendents or operators had been forced to keep their own records as best they could to keep current operating costs within the limits of current cash revenues. Records were crude, as the superintendents usually had no knowledge of basic accounting principles. Generally, the water works office was considered only a place to collect water rents, pay bills and

report the cash balance. In few places were the superintendents in a position to determine costs for the various phases of operation.

To impress upon officials the importance of proper accounting was a difficult task. In some places, steps were taken to provide efficient personnel and necessary equipment only after years of state auditing. In one community, the state examiners wrote up the books and prepared annual statements of operations for eight consecutive years before a change to proper methods made possible the preparation of statements by office personnel. In another case, where operating statements were made and unit costs of operation determined by the state examiners, they were surprised to find that the superintendent had already determined unit costs by his own method, noting them on an old envelope which he carried in his pocket. Comparison showed his results to be almost identical with those found in the audit, but he could produce no records to support his figures and could not direct one to where such data were to be found.

It is not the author's intention to leave the impression that this situation prevailed in *all* municipally owned utilities. Some had good accounting systems, but such inadequacies as described were all too common. Since the authorization, those utilities whose systems were poor, or who had none, have installed forms prescribed by the department, or have installed approved hand and machine systems. In recent years, too, many municipalities have acquired water plants by construction or by purchase from private owners. It is apparent from the requests for installation of proper systems that, in most cases, they realize the need of proper accounting. In some of these latter instances, the municipalities have retained both superintendent and accountants employed by the private utility to their own advantage.

Relation of Superintendent's and Accountant's Duties

Once an adequate accounting system is provided it rests with the personnel to make it effective. This is primarily the task of the superintendent and the accountant working in close co-operation to realize the full benefits available.

It is the duty of the superintendent to supervise all phases of the operations and to assume responsibility for the preservation of the physical properties. He must approve or have knowledge of all purchases and must know where and how all equipment and materials are used. It is his duty to provide water service to the public and to supervise sales and delivery. The superintendent may have supervisory authority over the collection and accounting office or it may be a separate department. In either case, the accountant should be in direct supervision of the accounting.

The superintendent should have some knowledge of accounting—at

least enough to understand what information is needed by the accounting office—as it is his duty to see that the accountant is furnished with the correct data. Only if he is able to do this can the accountant record the transactions properly and accurately.

The accountant, in turn, must be able to furnish the superintendent with statements showing unit costs of the various phases of operation and a correct and complete statement of finances. Not being acquainted with the technical side of operation, however, the accountant should confine his efforts to seeing that the proper accounting system is made available, that records are kept properly, and that a statement of operations or any other such information may be furnished the superintendent upon his request.

The present day water plant superintendent depends more and more upon his accounting records. Some of the many types of reports made available to him by the accountant are:

1. A summary statement of operating revenues and expenses, with totals to date for the year and comparisons with previous years
2. Detailed analyses of revenues and costs, by groups, including comparisons with previous years
3. Unit-basis operational cost statements, such as cost per consumer or cost per million gallons pumped
4. Unit construction cost statements, such as cost per foot or cost per consumer served
5. Up-to-date inventories of materials and supplies
6. Complete inventories of equipment and other fixed assets
7. Records of water consumed and billed, for comparison with amounts pumped
8. Unit costs of fuel or power used, for comparison with previous years and with those of other utilities
9. An accurate and complete balance sheet, including proper reserves.

On the other hand, the accountant depends, in large measure, upon the superintendent for the accuracy and proper allocation of the information which he presents in the form of records and statements. Some of the information for which he must depend upon the superintendent includes:

1. Classification of nearly all expenditures, the proper accomplishment of which directly affects the accuracy of reports and statements
2. Ascertaining that stock rooms are supplied, that the proper stock records are kept, and that issues are made only with proper authorization
3. Estimation of life of equipment
4. Proper differentiation between replacements or maintenance and additional or new equipment and buildings, using inventory records in the allocation

5. Preparation of unit cost statements, data on fuel consumed, power used, pipe laid, gallons pumped and similar information, much of which should be available in the plant record

6. Meter data.

Value of Statements and Records

The effectiveness of the accounting system is measured by the use to which the information it makes available is put. Statements of comparison with previous years, with explanations of increases and decreases, often reveal financial leaks that would otherwise remain unnoticed. Explanations of variations may reveal the necessity for changes in policies or procedures.

In the operational end, periodical comparison of amount of water billed with the gallonage pumped gives a valuable check on unaccounted-for water, and adequate records of materials and supplies are important in that they serve as a check against unauthorized removal or improper issuance of stores and may be used as a reference in making purchases.

Accurate statements of the financial condition and operations are the only safe basis for changing consumer rates. Failure to charge adequate depreciation to current expenses, the capitalization of items that might properly be charged to maintenance expense, the failure to set up reserves, and other faulty accounting methods result in inflated profits. In this connection, the superintendent should not let his enthusiasm for making large profits cause him to classify as construction and depreciation reserve charges items which properly analyzed are purely a maintenance charge. Rate reductions made on the basis of such false profits often reduce revenues to the point where, actually, the water works operates at a loss.

Applications to Operating Techniques

In certain phases of operations, the techniques employed and the accounting procedures are directly interdependent. In these cases, of course, the necessity for co-operation between the superintendent and the accountant is most obvious, but some discussion of the problems involved is pertinent.

Meter Reading

Experience has shown that there is a wide variance in meter reading techniques and records. The most advisable method seems to be to read in hundreds of gallons or tens of cubic feet, except, of course, on a final reading. This method speeds up, and eliminates errors in, both reading and billing, the gain in time from which would seem to offset any loss over

a reading of all units. Certainly, it reduces the number of complaints and re-reads.

Materials and Supplies

The accountant cannot make an intelligent distribution of materials and supplies purchased unless the superintendent first makes a proper distribution, to do which he must keep stores and stock records.

In many of the smaller utilities, purchases of materials and supplies are charged directly to operating expense, maintenance or construction, regardless of whether or not the items are used immediately. By taking an inventory at the close of the year or accounting period and adjusting the various accounts, the resulting expense distribution is corrected—but only approximately. Any loss or misuse of stock is reflected in the operating expense, as may be the use of materials and supplies for new construction. A "Materials and Supplies Stores and Stores Account," supported by proper subsidiary records, is the only accurate method by which proper accounting may be made of the disposition of all purchases. In supervising accounting procedure in Indiana utilities, the Department of Inspection and Supervision of Public Offices has recommended that such records be installed.

In connection with expense distribution and accounting for stock in stores, a purchase order system is an all-important method of control. It will, to a great extent, solve the difficulties between the superintendent and the accountant regarding the distribution or classification of expense.

At present, the demand for more accurate records is increasing. Because of the war emergency, the federal government has limited the purchases of certain items, and those which the utilities are permitted to purchase must be used for specific purposes. Records should be so kept that they reflect this information accurately and show that the utility is complying with the emergency regulations. From time to time federal agencies will call upon the utilities to furnish certain information, which, without adequate records, it will be impossible to give. Failure in this respect may result in the refusal of priority in the purchase of items essential to the operation of the utility. It is vitally important that the utility be able to give an accurate inventory of various items on hand, which it is now permitted to purchase under a priority rating.

A storeroom kept under lock and key, where materials and supplies are requisitioned as needed, usually makes possible a reduction in purchases and a great saving to the utility. Such a storeroom should be maintained under the direct supervision of a storekeeper accountable to the superintendent, who, in turn, must see that stores transactions are transmitted to the accountant.

Payroll Distribution

The superintendent is responsible for reporting to the accountant the proper distribution of the payroll; otherwise, the various phases of operation may not bear the proper proportion of the personal service expense. The superintendent directs the work to be done and the accounting department must necessarily look to him, or to those directly responsible to him, for the proper breakdown of the payroll.

The accounting department should furnish the superintendent with the necessary records, including time cards, payroll sheets, and a complete classification of accounts.

Plant and Equipment

Accounting for properties is not as accurate and complete in municipal utilities as in those privately owned, although more attention is being given to it today than at any previous time. To set up an accurate plant and equipment record requires a great amount of work and detailed information, but once established it is of great value to the utility. Often a complete appraisal is required because of the neglect of proper accounting in the former years.

Without proper records which classify units of property and equipment and which provide for the recording of cost, date of acquisition, the expected life, cost of repairs and other data, there is no basis on which to make depreciation charges or to determine the depreciated value of units which are to be retired or replaced. The close co-operation of superintendent and accountant is necessary in the retirement of properties so that the proper entries may be made on the records. Often, plant and equipment accounts are inflated due to the neglect of the superintendent to report retired properties. In one instance, soon after taking over supervision of utility accounts, the state examiners reported that one water utility had included three entire water plants (with the exception of land) in its plant valuation. It was revealed that, since the original acquisition, the plant had been reconstructed and new equipment installed on two different occasions over a period of years and that no record had been made of retirement of the old plants. This, of course, is an extreme case, but it does show what can happen with improper accounting methods.

Delinquent Accounts

Both superintendent and accountant are interested in the important subject of collections, and close co-operation is necessary to reduce delinquencies and to hold them at a minimum. Collections are a matter of educating the consumers in the rules and regulations regarding delinquency.

Here, the superintendent and accountant must combine their efforts toward proper control. If set rules are followed, without interference, a saving to the utility and an elimination of ill will on the part of the consumers will result.

Accumulated delinquencies in many cases are due to causes beyond the consumer's control. A plan of collection of such accounts, which has been used satisfactorily in a number of utilities in recent years, is to require a certain percentage of the delinquency to be paid each month together with the current bill. This is generally accepted by the consumer as a fair method in that it eliminates the addition of further service charges as long as the current bill is paid.

From this discussion, the need for proper accounting control, as well as for close co-operation between the accountant and superintendent in the administration and operation of the plant should be obvious. Both of these are key positions, which must be filled by men especially trained for each type of work; but for maximum efficiency of the plant both officials must have an appreciation of the interdependency of the two positions and the necessity for teamwork. Only if both men are competent and only if both are willing to accept their responsibilities to each other can the utility function smoothly and with maximum efficiency.

Perforated-Pipe Underdrains for Rapid Sand Filters

By Edwin A. Schmitt and Philip O. Macqueen

THE use of the perforated-pipe type of underdrains for rapid sand filters is more widespread throughout the United States and Canada than all other types combined, for which reason an accurate summary of specific data on the features of its design should be of value to water works engineers. With this idea in mind and for its own use in connection with the water supply system of Washington, D.C., the United States Engineer Office sent the following letter to the heads of water works departments of all cities in the United States and Canada with populations in excess of 50,000 which were known to have rapid sand filter plants in service:

"This office has charge of the purification of water for Washington, D.C., and is considering rebuilding the rapid sand filter underdrain system of the Dalecarlia Filtration Plant. It is proposed to use perforated pipes for this purpose and it is desired to secure data as to present practice. . . ."

"Data available from the various technical journals and magazines are not sufficiently comprehensive for this purpose and it is, therefore, necessary to obtain this information by means of a questionnaire to the various cities using perforated pipe underdrains.

"This information will be tabulated on a large summary sheet and a copy will be furnished each party supplying data. Additional columns will be added to this summary sheet to include comparative data on pipe underdrain system ratios. Approval has been given to publish this summary together with general remarks in the JOURNAL of the American Water Works Association. The purpose of this summary is to analyze the trends governing the design and use of perforated pipe underdrains. . . ."

The response to this letter was most complete and interesting, and the United States Engineer Office wishes to thank the many water works officials who so carefully co-operated in supplying the requested data.

A contribution by Edwin A. Schmitt, Principal Engineer, and Philip O. Macqueen, Senior Engineer, U. S. Engineer Office, Washington, D.C.

TABLE 1

Data on Perforated-Pipe Filter Underdrains

(Filters with sand areas of 1,300 to 2,200 sq.ft.)

	BUFFALO, N.Y.	CINCINNATI, OHIO	DIVISION AVE. PLANT CLEVELAND, OHIO	BALDWIN PLANT CLEVELAND, OHIO	COVINGTON, VA.	MOFFAT PLANT DENVER, COLO.	HAMILTON, ONT.	KANSAS CITY, MO.	LOUISVILLE, KY.—1	LOUISVILLE, KY.—2
Filter Data										
Number of filter units	40	40	36	40	3	10	12	24	8	6
Rating of filter (mgd.)	4	4	$4\frac{1}{6}$	$4\frac{1}{6}$	4	4	4	4	6	6
Length of filter (ft.)	50	50	49	49	27	$36\frac{3}{4}$	45	$49\frac{1}{4}$	50	$40\frac{1}{2}$
Width of filter (ft.)	$31\frac{1}{2}$	31	2@14.83	2@14.83	2@26	2@19	$37\frac{1}{2}$	2@14	48	$58\frac{3}{4}$
Net sand area (sq.ft.)	1,400	1,400	1,454	1,454	1,404	1,393	1,440	1,379	2,100	2,130
Depth of sand (in.)	26	27	24–27	30	27	27	30	27	30	26
Depth of gravel (in.)	16	18	25–22	22	21	24	20	18	24	24
Sand surface to top of gutter (in.)	24	29	26–30	25	27	27	42	24	24	30
Location main gutter*	C	C	C	C	C	C	C	C	C	C
Date underdrains installed	1926	1936–7	1916	1925	1933	1937	1933	1928	1928	1931
Pipe Lateral Data										
Diam. of laterals (in.)	3	3	$2\frac{1}{2}$	$2\frac{5}{8}$	2	4	4	3	2	2
Length of laterals (ft.)	$5\frac{1}{2}$	6	$6\frac{1}{4}$–$6\frac{1}{2}$	6.2	6	$18\frac{3}{4}$	$7\frac{1}{2}$	13	$7\frac{1}{2}$	6
Spacing of lateral (in.)	$11\frac{1}{2}$	12	$6\frac{5}{64}$	7	12	9	12	10	8	8
Clearance under lateral (in.)	2	2	4	$2\frac{7}{8}$	$2\frac{3}{4}$	5	2	$1\frac{3}{8}$	2	2
Number of laterals per filter	280	224	384	336	208	98	180	120	360	432
Material of laterals	C.I.	C.I.	C.I.	C.I.	Galv.St.†	C.I.†	C.I.	Galv.St.	C.I.	C.I.
Perforation Data										
Diameter of holes (in.)	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{11}{32}$	$\frac{19}{32}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{3}{8}$
Number of holes per lateral	28	25	34	17	7	37	15	42	12	12
Spacing of holes c. to c. (in.)	$4\frac{3}{4}$	3	$2\frac{1}{2}$	$4\frac{9}{32}$	$11\frac{9}{16}$	6	6	$3\frac{3}{4}$	8	6
Holes staggered? (Yes or No)	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Total no. holes per filter	6,720	5,600	13,024	5,692	1,456	3,626	2,692	4,800	4,700	5,616
Holes bushed? (Yes or No)	Yes	No	No	No	No	Yes	Yes	No	No	No

	MILWAUKEE, WIS.	MINNEAPOLIS, MINN.	NEW ORLEANS, LA.	OMAHA, NEB.	OTTAWA, ONT.	PROVIDENCE, R.I.	SACRAMENTO, CALIF.	HOWARD BEND PLANT ST. LOUIS, MO.	TORONTO, ONT.	TULSA, OKLA.
Filter Data										
Number of filter units	32	20	18	18	10	10	16	20	20	6
Rating of filter (mgd.)	6	4	4	4	4.2	4.8	4	4	6	4
Length of filter (ft.)	57	40	53	51	56	55	58	50	68	50
Width of filter (ft.)	38	35	2@$13\frac{1}{2}$	32	26	35.83	28	35	35.58	28
Net sand area (sq.ft.)	2,166	1,400	1,431	1,505	1,456	1,735	1,305	1,400	2,100	1,400
Depth of sand (in.)	27	30	36	24	34	30	24–28	24	26	24
Depth of gravel (in.)	24	16	7–10	9	20	18	24	18	20	18
Sand surface to top of gutter (in.)	27	25	30	22	26	24	48	20	24	26
Location main gutter*	C	F	C	C	S	C	C	S	C	C
Date underdrains installed	1939	10–1927 10–1930	1929–30	12–1923 6–1933	1932	1926	1924	1929	1940	1930
Pipe Lateral Data										
Diam. of laterals (in.)	4	$2\frac{1}{2}$	$4\frac{1}{8}$	3	4	3	3	4–3	4–$2\frac{1}{2}$	2
Length of laterals (ft.)	$18\frac{3}{4}$	5.43	13.5	6	12.6	6.33	11	27.83	16	13.83
Spacing of lateral (in.)	9	10	12	24	12	8.7	12	12	12	12
Clearance under lateral (in.)	3	$2\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2.8	1	1.6–2.1	$1\frac{1}{2}$	$\frac{3}{4}$
Number of laterals per filter	152	288	104	100	112	346	116	50	136	98
Material of laterals	C.I.	C.I.	Brass	C.I.	C.I.	C.I.†	Steel	C.I.	C.I.	Brass
Perforation Data										
Diameter of holes (in.)	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{4}$¶	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{1}{4}$¶
Number of holes per lateral	37	10	108	24	13	8	22	100	15	108
Spacing of holes c. to c. (in.)	6	$3\frac{9}{16}$	$1\frac{1}{2}$	3	12	10.31	6	3.36	12	$1\frac{1}{2}$
Holes staggered? (Yes or No)	No	Yes	Yes	No	No	No	No	Yes	No	Yes
Total no. holes per filter	5,624	5,616	11,232	2,400	1,456	2,780	2,552	5,000	2,103	10,584
Holes bushed? (Yes or No)	No	Yes	No	Yes	Yes	No	No	Yes	Yes	No

Total no. holes per filter	6,720	5,600	13,624	8,[illegible]	[illegible]	[illegible]														
Holes bushed? (Yes or No)	Yes	No	No	No	No	Yes	Yes	No	No	No	No	Yes	No	Yes	Yes	No	No	Yes	Yes	No
Wash Water Data																				
Normal washing rate (in. rise per min.)	24	24	23	33½	24	26	30	24	24	24	24	20	24	24	27	20	30	30.2	24	25
Max. wash. rate (in. rise per min.)	32	28	33	35½	24	26	40	24	32	32	33	30	30	24	33	28	30	33.2	—	—
Capacity of W.W. tank (1,000 gal.)	240	843	460	424	100	223½	202	150	550	550	760	140	—	350	300	400	250	196	170	120
Tank floor above filter gutter (ft.)	48	32.5	35	44.1	35	29.75	29	20	62	62	50	40.5	—	28.7	12.6	22	24	21.7	25.5	9.33
Diam. W.W. inlet valve (in.)	24	36	24	24	20	30	24	24	30	24	36	24	24	24	36	2@24	24	24	30	30
General Information																				
Would you change to another type of strainer system if you built new filters?	Yes	No	‖	‖	No	No	—	Yes	Yes	Yes	No	No	No	No	No	No	No	‖	No	No
Is your filter sand clean enough?	No	Yes	No	No	Yes	Yes	Yes	—	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—
Is surface wash used?	No	No	No	No	No	No	No	No	Yes	No	Yes	No	No	No	No	No	No	No	No	No
Is air agitation used?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Is deficiency due to strainer system or rate of washing?	Both	—	Both	Both	—	—	—	—	No	No	—	—	—	—	—	—	—	—	—	—
Any trouble from corrosion?	No	No	Yes	—	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	—	No
Minimum pH filtered water	—	8.0	7.0	7.0	6.3	6.7	7.6	7.9	—	6.4	7.2	6.7	9.0	7.8	4.7	9.5	6.5	7.2	—	7.2
Average pH filtered water	7.8	8.4	7.4	7.4	8.2	7.7	8.0	8.1	—	6.8	7.7	6.9	9.3	8.1	5.3	9.8	6.8	9.1	—	7.6
Effective size sand (mm.)	0.45	0.45	0.48	0.38	0.50	0.45	0.44	0.42	0.50	0.40	0.50	0.50	0.52	0.475	0.47	0.40	0.40	0.462	0.50	0.36
Uniformity coefficient of sand	—	1.50	1.50	1.70	—	1.45	1.6	—	1.3	1.3	1.32	1.55	1.28	1.75	1.39	1.6	1.4	1.48	1.3	1.7
Minimum size gravel (in.)	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{16}$	—	$\frac{1}{10}$	$\frac{3}{16}$	$\frac{1}{20}$	$\frac{1}{16}$
Maximum size gravel (in.)	2½	2	1½	1½	2	2½	2½	2½	2	2½	3	2¼	1½	1½	1½	—	2½	2½	3	2¼
Is high velocity wash an important factor in keeping sand clean?	—	—	Yes	Yes	Yes	—	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Are you considering change of washing rate?	No†	No	No	No	No‡	Yes‡	No	No	Lower	Lower§	No	No	No	No	No	No	No	No	No	No

* C = Center; F = Front; S = Side.
† Cement-lined.
‡ Might add surface wash.
§ Adding surface wash.
¶ Oblong holes.
‖ Would consider.

TABLE 2

Data on Perforated-Pipe Filter Underdrains

Filters with sand areas of 800 to 1,300 sq.ft.

	ATLANTA, GA.	AUGUSTA, GA.	CEDAR RAPIDS, IOWA	COLUMBUS, OHIO	MARSTON LAKE PLANT DENVER, COLO.	SPRINGWELLS PLANT DETROIT, MICH.	KANSAS CITY, KANS.	KNOXVILLE, TENN.	LOUISVILLE, KY.	MIAMI, FLA.
Filter Data										
Number of filter units	7	5	4	8	14	68	5	6	12	8
Rating of filter (mgd.)	3	3	3	3	5	4	2.8	2½	3	2½
Length of filter (ft.)	42	35¼	30	46⅔	55⅓	40⅓	30	33½	47	43¾
Width of filter (ft.)	26	34½	35	26.2	23	27	32	29.1	23	20
Net sand area (sq.ft.)	1,019	1,029	1,050	1,089	1,285	1,089	960	972	1,081	875
Depth of sand (in.)	24	30	30	24	48**	20	24	30	26	30
Depth of gravel (in.)	18	14	24	18	15	18½	18	24	14	34
Sand surface to top of gutter (in.)	24	27	24	24	48	39½	24	26	24	25
Location main gutter*	C	C	C	C	S	F	C	C	F	C
Date underdrains installed	1922	1929	1930	1922	1925	1930	1927	1927	1934	1925
Pipe Lateral Data										
Diam. of laterals (in.)	2½	3	2	2	3	4	4-3	3	2	2½
Length of laterals (ft.)	5	—	7	5¼	22½	12.1	16	13¼	5	10
Spacing of laterals (in.)	6⅜	13	8	6⅜	8	12	12	8	6	8
Clearance under lateral (in.)	4	6	1¾	3⅝	1	1½-2	—	$2\frac{3}{16}$	Emb.	2
Number of laterals per filter	320	—	272	352	83	80	60	100	326	132
Material of laterals	C.I.	Copper	C.I.	Wr.St.	W.I.	C.I.	C.I.	C.I.	C.I.†	C.I.
Perforation Data										
Diam. of holes (in.)	$\frac{5}{16}$	$\frac{15}{32}$	⅜	¼	⅜	½	⅜	⅜	⅜	⅜
Number of holes per lateral	8	—	15	30	68	24	45	26	10	20
Spacing of holes c. to c. (in.)	9	6	3	$2\frac{1}{16}$	4	6	4¼	6	6	6
Holes staggered? (Yes or No)	Yes	Yer	Yes	Yes	No	No	No	No	No	No
Total no. holes per filter	2,560	—	4,080	10,560	5,644	2,200	2,700	2,600	3,548	2,640
Holes bushed? (Yes or No)	No	No	No	No	No	Yes	No	No	Yes	No

	MONTREAL, QUE.	SAN LEANDRO PLANT OAKLAND, CALIF.	ORINDA PLANT OAKLAND, CALIF.	SAN PABLO PLANT OAKLAND, CALIF.	OAKLAND, CALIF.	RICHMOND, VA.	ST. PAUL, MINN.—1	ST. PAUL, MINN.—2	ST. PAUL, MINN.—3
Filter Data									
Number of filter units	48	6	8	4	8	10	12	1	3
Rating of filter (mgd.)	3¼	3	3½	3½	1.5	3	3⅓	3⅓	3⅓
Length of filter (ft.)	50	44	30.2	30	30	44	33	33⅓	33⅓
Width of filter (ft.)	27½	28	40.4	40.6	18	28⅓	42	42	42
Net sand area (sq.ft.)	1,200	1,232	1,224	1,220	540	1,078	1,240	1,253	1,253
Depth of sand (in.)	30	30	30	30	30	26	27	25	25
Depth of gravel (in.)	15	18	22	18	18	16	16	23	23
Sand surface to top of gutter (in.)	17	20	35	24	24	24	22	25	25½
Location main gutter*	C	S	S	S	S	C	C	C	C
Date underdrains installed	1915 1928	1927	1935	1938	1933	1924	1922	1938	1938
Pipe Lateral Data									
Diam. of laterals (in.)	1¾	3	3	2½	2½	3½	3	3	3
Length of laterals (ft.)	6	14.83	9.58	9½	9	12	6¼	7.2	7.2
Spacing of laterals (in.)	6	9	7½	7½	7½	11	12	18¾	12
Clearance under lateral (in.)	1½	$1\frac{7}{16}$	¾	$1\frac{1}{16}$	$1\frac{1}{16}$	1¾	2	2	2
Number of laterals per filter	368	116	192	192	96	192	168	108	168
Material of laterals	C.I.	Brass	Brass	Brass	Brass	C.I.	C.I.	C.I.	C.I.
Perforation Data									
Diam. of holes (in.)	$\frac{3}{16}$	⅜	⅜	$\frac{7}{16}$	—	$\frac{5}{16}$	$\frac{7}{16}$	$\frac{15}{32}$	$\frac{7}{16}$
Number of holes per lateral	24	28	24	18	16	—	25	30	25
Spacing of holes c. to c. (in.)	3	6	5	6½-7½	6½	6	3¾	3	3¾
Holes staggered? (Yes or No)	Yes	No	No	No	No	No	Yes	No	Yes
Total no. holes per filter	8,832	3,248	4,608	3,456	1,536	4,272	4,032	3,240	4,200
Holes bushed? (Yes or No)	Yes	No	No	No	No	Yes	No	No	No

Holes bushed? (Yes or No)	No	No	No	No	No	Yes	No	No	Yes	No	Yes	No	No	No	No	Yes	No	No	No
Wash Water Data																			
Normal washing rate (in. rise per min.)	30	24	24	24	25	36	24	24	24	26	16	24	36	30	—	24	20	36	36
Max. washing rate (in. rise per min.)	36	30	26	24	25	42	24	30	26	26	—	26	36	30	—	30	24	36	36
Capacity W.W. tank (1,000 gal.)	400	—	100	50	150	90	100	150	—	100	104	80	200	80	—	100	—	—	—
Tank floor above filter gutter (ft.)	25	—	18¾	20	35.5	32	34.75	39.75	62	22	20	19½	39.75	38.5	—	20	33⅓	33⅓	33⅓
Diam. W.W. inlet valve (in.)	24	18	24	20	16	24	30	24	20	20	24	24	24	24	—	24	24	24	24
General Information																			
Would you change to another type of strainer system if you built new filters?	No	No	No	No	No	—	No	No	Yes	Yes	—	No	No	No	No	No	—	—	—
Is your filter sand clean enough?	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—
Is surface wash used?	No	No	No	No‡	No	No	No	No	No‡	No	No	No	No	No	No	No	No	—	—
Is air agitation used?	No	No	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	No	—	—
Is deficiency due to strainer system or rate of washing?	—	—	—	No	No	—	—	Low rate	No	—	—	—	—	—	—	—	Low rate	—	—
Any trouble from corrosion?	Yes	No	No	No	No	No	No	No	Yes	No	No	No	No	††	††	No	No	—	—
Minimum pH filtered water	4.8	5.2	8.3	9.4	7.2	7.2	7.7	6.2	6.4	7.2	6.4	8.0	7.0	6.9		5.6	—	—	—
Average pH filtered water	6.4	7.0	8.6	10.5	7.8	7.5	7.9	6.9	6.8	7.6	7.7	8.3	9.3	7.1		6.3	—	—	—
Effective size of sand (mm.)	0.4	0.5	0.55	0.6	0.62	0.54	0.43	0.45	0.4	0.55	0.50	0.6	0.54	0.50		0.43	—	—	—
Uniformity coefficient of sand	1.65	1.7	1.6	—	1.78	1.52	1.51	—	1.3	1.6	1.68	1.5	1.58	1.39		1.45	—	—	—
Minimum size gravel (in.)	1/16	⅛	⅛	⅛	1/20	1/16	1/16	⅛	1/16	1/16	1/16	⅛	1/16	⅛		3/16	—	—	—
Maximum size gravel (in.)	1½	1½	2½	2½	¾	3	2½	1½	1½	2½	1	1¾	1¾	1¾		2½	—	—	—
Is high velocity wash an important factor in keeping filters clean?	Yes	Yes	Yes	—	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes		Yes	Yes	—	—
Are you considering a change of washing rate?	No	—	No	No	No	No	No	No	Yes	No	No	No	No	No		No	Higher	—	—

* C = Center; F = Front; S = Side.

† Cement-lined.

‡ Might add surface wash.

** Anthracite coal.

†† Original steel laterals, installed 1920, were replaced with brass in 1933, due to corrosion. Original wrought iron laterals, installed 1930, replaced with brass in 1938, due to corrosion.

TABLE 3

Data on Perforated-Pipe Filter Underdrains

Filters with sand areas of 400 to 800 sq.ft.

	AUSTIN, TEX.	AUSTIN, TEX.	BAY CITY, MICH.	COVINGTON, KY.	DALLAS, TEX.	FORT WORTH, TEX.	FORT WORTH, TEX.	FORT WORTH, TEX.	GRAND RAPIDS, MICH.	GREAT FALLS, MONT.	GREAT FALLS, MONT.	HARRISBURG, PA.	INDIANAPOLIS, IND.	LIMA, OHIO	LITTLE ROCK, ARK.	MACON, GA.	OKLAHOMA CITY, OKLA.	RACINE, WIS.—1	RACINE, WIS.—2	SAGINAW, MICH.	SHEBOYGAN, WIS.—1	SHEBOYGAN, WIS.—2	WILMINGTON, DEL.	WINDSOR, ONT.	YORK, PA.
Filter Data																									
Number of filter units	8	4	10	12	20	4	8	10	5	4	8	20	6	6	4	10	8	8	4	12	6	3	10	10	6
Rating of filter unit (mgd.)	1¼	1¼	2	1.6	2.5	1¼	1¼	2	2.5	3	1½	1	2	1⅓	2	1.2	2	1½	2	2.1	2	2	2	2.6	1¾
Length of filter (ft.)	25	25	28½	28	28	25	25	27⅔	36	25½	24	27	20¾	22½	25	27⅔	29	28⅓	30½	28	31	31	36	28	26
Width of filter (ft.)	18	18	28½	20	26	21⅓	21⅓	29.83	20½	28½	22½	16	34¾	21⅓	28	16¼	24	18½	26¼	26	25⅓	25⅓	20¼	25	26⅓
Net sand area (sq.ft.)	450	450	700	560	728	450	450	728.5	738	727	540	432	721	480	700	406	696	525	700	728	700	700	728	700	610
Total depth of sand (in.)	26	26	30	27	30	27	27	27	30	30	30	30	30	24	30	27	24	30	30	26	30	30	24	36	18
Total depth of gravel (in.)	18	18	18	21	18	18	18	18	15	18	18	7	22	18	18	21	18	24	27	18	19	24	18	15	27
Sand surface to top of gutter (in.)	24	24	27	24	24	24	24	36	15	24	24	14	24	28	30	24	12	24	24	28	24	24	24	25	30
Location main gutter*	C	C	C	C	C	C	C	C	C	F	F	—	S	F	C	F	C	F	C	F	C	C	C	C	C
Date underdrains installed	1925	1938	1925	1937	16–1929 4–1936	1918	1923	1931	1935	1933	1938	12–1904 8–1922	1926	1935	1938	1933	1923	1927	1936	1929	1931	1940	1933	1926	1932
Pipe Lateral Data																									
Inside diameter of laterals (in.)	2	1¾	3½	4	3	1¾	2	2	2	3	2	1⅜	3	2½	4	2½	3	2	2½	2½	3	2½	1¾	2⅞	3
Length of laterals (ft.)	4	4	6¼	10	13	4	4	6.17	4½	14	10	7¾	8¼	10½	14	7½	12	16.2	11	7	11	11	4½	11½	11⅓
Spacing of laterals (in.)	12	6¼	11	12	12	6¼	6¼	6	12¼	12	6	6	11⅝	6	12	9	8	6	8¼	8⅛	13¼	8	6	7	10
Clearance under laterals (in.)	2	2	3	2	2¼	1¾	1¾	1¾	1¾	1 3/16	1	3	2	1	6	1¾	1	1½	1½	2½	2	1¼	1¾	2	1
Number of laterals per filter	96	192	62	56	56	192	192	220	136	50	46	108	80	90	50	66	43	112	88	152	56	92	288	96	64
Material of laterals	C.I.	C.I.	W.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	W.I.	C.I.	C.I.	C.I.†	Copper	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.	C.I.
Perforation Data																									
Diam. of holes (in.)	3/8	9/32	½	½	7/16	9/32	3/16	5/16	¼	3/8	3/8	7/32	7/16	¼	3.8	7/16	9/16	¼	7/16	3/8	3/8	3/8	¼	3/8	5/16
Holes per lateral	10	8	24	22	24	16	8	12	18	52	40	30	16	41	55	16	24	32	17	17	45	22	9	20	40
Spacing of holes (in.)	5	5	6¼	5	6	3	6	6	3	3	3	3	6	3	3	6	6	3	8	5⅛	3	6	6	7	3¾
Holes staggered? (Yes or No)	No	No	No	Radial	No	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No	No	No	No	Yes
Total no. holes per filter	960	1,536	1,536	1,232	1,344	3,216	1,536	2,695	2,736	2,600	1,840	3,240	1,320	3,780	2,750	1,056	1,032	3,584	1,496	2,584	2,520	2,024	2,592	2,064	2,560
Holes bushed? (Yes or No)	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	Yes	No	No	Yes	Yes	Yes

Wash Water Data																									
Normal washing rate (in. rise per min.)	24	24	24	20	20	18	18	24	23	30	24	9.6	24	24	25	30	24	25½	25½	28	24	24	36	16	23.7
Max. washing rate (in. rise per min.)	36	36	30	22.5	30	19	19	24	28	48	34	9.6	36	28	35	—	24	25½	25½	31	27	—	36	18	24.3
Capacity of W.W. tank (1,000 gal.)	50	50	105	250	—	200	200	200	200	102	102	—	125	35	150	100	100	100	100	125	100	100	100	—	70
Tank floor above filter gutter (ft.)	37	37	22	20	—	13.7	13.7	13.6	20	45	45	—	12⅔	34	36	50	65	11.9	11.8	26	20	20	33⅓	—	21¾
Diam. W.W. inlet valve (in.)	18	18	16	20	24	20	20	24	20	20	20	10	20	14	24	20	20	24	24	24	12	12	20	16	24
General Information																									
Would you change to another type strainer system if you built new filters?	No	No	—	No	No	No	No	No	Yes	No	No	No	Yes	Yes	No	No	Yes	No	No	—	No	No	No	No	No
Is your filter sand clean enough?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	—	Yes	Yes	Yes
Is surface wash used?	No	No	No	Mech.	No	No	No	No	No	No	No	No	§	No	No	No	No	Yes	Yes	No	Yes	Yes	No	No	No
Is air agitation used?	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No
Is deficiency due to strainer system or rate of washing?	—	—	—	—	—	—	—	—	Rate	—	—	Rate	No	Str.	—	—	Str.	—	—	Rate	—	—	Str.	—	—
Any trouble from corrosion?	No	No	No	No	No	No	No	No	No	No	No	Some	Yes	Yes	No	No	Yes	No	No	—	No	—	Yes	No	No
Minimum pH filtered water	9.0	9.0	8.6	7.4	8.3	7.8	7.8	7.8	8.8	7.2	7.2	5.4	6.9	6.6	6.0	6.1	8.6	7.6	7.6	9.0	7.3	—	6.7	7.8	6.3
Average pH filtered water	9.4	9.4	9.0	8.1	9.2	8.0	8.0	8.0	9.3	7.4	7.4	6.8	7.6	7.0	6.1	6.5	9.5	7.75	7.75	9.2	7.5	—	6.9	8.1	6.6
Effective size of sand (mm.)	0.48	0.48	—	0.473	0.4	0.4	0.4	0.5	0.5	0.55	0.55	0.45	0.45	0.5	0.42	0.8	—	0.36 to	0.45	0.45	0.45	0.50	0.40	0.45	0.44
Uniformity coefficient of sand	1.6	1.6	—	1.34	1.8	1.65	1.8	1.7	1.33	1.30	1.30	1.5	1.7	1.50	1.6	1.7	1.5	1.3 to	1.6	1.5	1.6	1.5	1.58	1.5	1.54
Minimum size gravel (in.)	⅛	⅛	—	1/16	¼	3/16	3/16	3/16	1/16	1/16	1/16	1/16	1/16	1/16	1/10	1/16	—	⅛ to		1/16	⅛	⅛	1/16	⅛	⅛
Maximum size gravel (in.)	1½	1½	—	2½	2½	2½	1½	1½	2	2½	2½	¾	3	2½	2½	2½	—		1.5	2	1½	2½	2½	2	3
Is high velocity wash an important factor in keeping filters clean?	Yes	Yes	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	Yes	No	—	Yes	No	Yes
Are you considering a change of washing rate?	No	No	—	No	No	No	No	No	No	No	No	Yes‡‡	Yes	No	No	No	No	No	No	No	No	—	No	No	No

* C = Center; F = Front; S = Side.
† Cement-lined.
§ Surface wash recently installed.
‡‡ Higher.

TABLE 4

Data on Perforated-Pipe Filter Underdrains

Filters with sand areas of 200 to 400 sq.ft.

	ALLIANCE, OHIO	BEAUMONT, TEX.	BIRMINGHAM, ALA.	CHEYENNE, WYO.	COLUMBUS, GA.	GREENSBORO, N.C.	HAGERSTOWN, MD.	LA PORTE, IND.	LAWRENCE, MASS.	NORFOLK, VA.	PORT ARTHUR, TEX.	SAN DIEGO, CALIF.	SANDUSKY, OHIO	SPRINGFIELD, MO.	TOLEDO, OHIO	TOPEKA, KAN.	WAUKEGAN, ILL.	WINSTON-SALEM, N.C.
Filter Data																		
Number of filter units	12	4	6	12	4	6	10	4	10	6	5	16	10	6	56	12	10	12
Rating of filter unit (mgd.)	1	1	1	1	1	1	1	1	1	⅔	1	1	1	1	1	1	1	1
Length of filter (ft.)	18¾	20	20¼	22½	24	22	24	18	20⅓	19⅓	21.8	18 dia.	20	25⅓	22	20	20	20
Width of filter (ft.)	18¾	18	17¼	16	16	16	18	20	18	11¾	20	Cir.	18	14⅓	18	18	18	18
Net sand area (sq.ft.)	352	360	349	360	384	352	369	360	366	227	361	254	360	370	306	360	360	360
Total depth of sand (in.)	30	36	30	32	30	30	30	10	30	30	30	34	33	24	24	30	30	29
Total depth of gravel (in.)	24	18	18	10	19	18	18	38	18	18	18	36	9	17	15	18	21	22
Sand surface to top of gutter (in.)	17	19	24	18	21	27	24	12	32	29	22	23	30	12	24	24	27	24
Location of main gutter*	F	F	F	—	F	F	F	F	S	C	C	—	F	F	F	F	—	F
Date underdrains installed	1918	1925	1939	1915–28	1927	1922	1928	1928	1938	1933	1926	1928	1909	—	1918	1922	1929	1924
Pipe Lateral Data																		
Inside diameter of laterals (in.)	3	2	2	2	3 5/16	3	2¾	2½	3	2	3	2	1¼	2	2	3	2	2
Length of laterals (ft.)	9	8.2	8¼	4	7½	7⅔	8	4	19½	5¼	9½	3–8⅓	4	6⅓	18	9	9	4.83
Spacing of laterals (in.)	7½	8	6¼	4	12	12	8	6	6	6	9⅞	8¾	6	8	6	12	—	6
Clearance under laterals (in.)	1	2	2	1	1	1½	3¼	2	1	3	—	6	5	3	¾	2	—	1¾
Number of laterals per filter	62	60	76	272	48	42	60	144	36	76	44	46	160	94	44	40	40	144
Material of laterals	Steel§§	C.I.	C.I.†	C.I.	C.I.	C.I.	C.I.	C.I.†	C.I.	Copper	C.I.	Steel	C.I.	Steel	C.I.	Steel	Brass	W.I.
Perforation Data																		
Diam. of holes (in.)	¼	¼	¼	¼	15/32	½	⅜	3/16	¼	3/16	⅜	⅛	⅜	3/16	3/16	½	—	⅜
Holes per lateral	47	15	34	24	15	15	16	14	75	11	28	16–44	9	25	54	18	—	10
Spacing of holes (in.)	2¼	6	3	2	5⅞	6	6	3	3	6	4	2¼	6	3	4	6	—	6
Holes staggered? (Yes or No)	Yes	No	Yes	½Yes ½No	No	Yes	Yes	Yes	Yes	No	Yes	—	No	Yes	No	No	—	No
Total no. holes per filter	2,914	900	2,584	6,528	816	630	1,062	2,016	2,700	836	1,232	1,648	1,440	2,350	2,376	720	—	1,440
Holes bushed? (Yes or No)	No	No	Yes	No	No	Yes	No	Yes	No	No	No	—	No	No	No	No	No	No

Wash Water Data																		
Normal washing rate (in. rise per min.)	20	24	24	13.2	24	24	24	—	28	28	22	16	14	23	22	24	20	24
Max. washing rate (in. rise per min.)	—	24	—	22.7	26	24	24	—	48	28	22	21	16	26	26	24	20	31
Capacity of W.W. tank (1,000 gal.)	35	—	150	—	50	70	75	40	125	—	—	—	50	112	70	50	—	60
Tank floor above filter gutter (ft.)	20	—	8¼	—	80	31¾	17	15	—	—	—	—	—	36	30	40½	—	—
Diam. W.W. inlet valve (in.)	12	12	16	16	12	12	12	16	24	10	14	10	14	10	20	14	12	14
General Information																		
Would you change to another type strainer system if you built new filters?	No	No	No	—	No	Yes	No	No	No	Yes	No	No	Yes	No	Yes	No	No	—
Is your filter sand clean enough?	Yes	Yes	Yes	Yes	Yes	Fair	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Is surface wash used?	No	No	No	No	No	No	No	No	Mech.	No	No	No	No	No	No	No	Mech.	Mech.
Is air agitation used?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No
Is deficiency due to strainer system or rate of washing?	—	—	—	Str.	—	—	—	Rate	—	Both	—	Both	—	—	—	—	—	—
Any trouble from corrosion?	Yes	No	—	No	Some‖	No	No	No	—	No	Some	No	Yes	No	Yes	No	No	No
Minimum pH filtered water	6.4	5.1	6.2	7.0	5.4	5.9	6.0	—	5.2	5.8	7.9	—	7.0	7.1	7.3	—	7.2	6.0
Average pH filtered water	7.1	5.9	7.3	7.2	5.9	6.2	7.0	7.3	5.7	6.3	8.5	7.6	9.1	7.3	7.5	9.4	7.4	6.2
Effective size of sand (mm.)	—	.44	.5	.45	.42	.45	.56	—	.46	.5	.45	.45	.4	.48	.38	.45	.39	.5
Uniformity coefficient of sand	—	1.65	1.6	1.6	1.65	1.65	1.47	—	1.9	1.45	—	1.75	—	—	1.5	—	1.75	1.70
Minimum size gravel (in.)	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	—	—	—	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	—	$\frac{1}{16}$
Maximum size gravel (in.)	2½	2½	2½	1½	2½	3	3	2	2½	2	—	—	—	3	2	2½	—	2½
Is high velocity wash an important factor in keeping filters clean?	Yes	Yes	—	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	—	No	No	Yes	No	Yes
Are you considering a change of washing rate?	No	No	—	Lower	Yes	Higher	No	No	No	Lower	No	Higher	—	No	Higher	No	No	No

* C = Center; F = Front; S = Side.

† Cement-lined.

§§ Original steel laterals replaced with cast iron in 1939.

‖ Would prefer cement-lined C.I. laterals.

For the purpose of ready comparison, the data compiled for the filtration plants have been divided into four main groups, dependent upon the size of the filters used and an estimated average rate of filtration of 125 mgd. per acre. With ranges of net sand area and approximate output for each filter, the tables are as follows: Table 1, 1,300 to 2,200 sq.ft., or 4 to 6 mgd.; Table 2, 800 to 1,300 sq.ft., or 2 to 4 mgd.; Table 3, 400 to 800 sq.ft., or 1 to 2 mgd.; and Table 4, 200 to 400 sq.ft., or 1 mgd. The discussion which follows is based upon a general analysis of the data contained in these tables.

TABLE 1A

Filters With Sand Areas of 1,300 to 2,200 sq.ft.

CITY	NET SAND AREA PER FILTER	TOTAL AREA OF ALL PERFORATIONS	TOTAL AREA OF ALL LATERALS	RATIO OF AREA OF PERFORATIONS TO AREA OF LATERALS	RATIO OF AREA OF PERFORATIONS TO NET SAND AREA	RATIO OF LENGTH TO DIAMETER OF LATERAL
	sq.ft.	*sq.ft.*	*sq.ft.*			
Buffalo, N.Y.	1400	2.201	9.817	0.23	0.0016	22
Cincinnati, Ohio	1400	4.300	10.995	0.40	0.0031	24
Cleveland, Ohio	1454	4.441	13.090	0.34	0.0031	31
Cleveland, Ohio	1454	3.670	12.628	0.29	0.0025	27
Covington, Va.	1404	2.800	4.538	0.62	0.0020	36
Denver, Colo.	1393	3.785	8.552	0.44	0.0027	56
Hamilton, Ont.	1440	4.646	15.708	0.30	0.0032	22
Kansas City, Mo.	1379	1.637	5.891	0.28	0.0012	52
Louisville, Ky.	2100	3.603	7.854	0.46	0.0017	45
Louisville, Ky.	2130	4.306	9.425	0.46	0.0020	36
Milwaukee, Wis.	2166	4.312	13.264	0.33	0.0020	56
Minneapolis, Minn.	1400	4.306	9.817	0.44	0.0031	26
Omaha, Neb.	1505	3.272	4.909	0.67	0.0022	24
Ottawa, Ont.	1456	4.467	9.774	0.46	0.0031	38
Providence, R.I.	1735	3.790	13.867	0.27	0.0022	28
Sacramento, Calif.	1305	2.664	5.695	0.47	0.0020	44
St. Louis, Mo.	1400	3.833	6.682	0.57	0.0027	42
Toronto, Ont.	2100	6.624	7.835	0.84	0.0031	59
Average				0.44	0.0025	37
Maximum				0.67	0.0032	59
Minimum				0.23	0.0012	22

The use of perforated-pipe underdrains began about fifty years ago with the rapid sand filters of the "tub" type. Because it was necessary to obtain a uniform backwash at a minimum cost, the natural solution was a metal-pipe grid with strainers. These early rapid sand filters of the gravity type, which were later equipped with revolving surface rakes, were more efficient in some respects than many of the best equipped present-day filters, and they still enjoy wide commercial use throughout the world.

Beginning about 1910, the size of rapid sand filters had to be increased greatly to avoid the expensive multiplicity of small units. Filters with capacities greater than 500,000 gpd. were made oblong in shape for the sake of economy and ease of layout. Many different types of underdrains were tried, but the perforated-pipe type, with some modifications, continued to hold first place in popularity.

Careful distinction should be made between the early type known as "pipe and strainer" and the present type of perforated-pipe underdrains.

TABLE 2A

Filters With Sand Areas of 800 to 1,300 sq.ft.

CITY	NET SAND AREA PER FILTER	TOTAL AREA OF ALL PERFORATIONS	TOTAL AREA OF ALL LATERALS	RATIO OF AREA OF PERFORATIONS TO AREA OF LATERALS	RATIO OF AREA OF PERFORATIONS TO NET SAND AREA	RATIO OF LENGTH TO DIAMETER OF LATERAL
	sq.ft.	*sq.ft.*	*sq.ft.*			
Atlanta, Ga.	1019	1.364	10.908	0.13	0.0013	24
Cedar Rapids, Iowa	1050	3.128	5.934	0.53	0.0030	42
Columbus, Ohio	1089	3.600	7.679	0.47	0.0033	32
Denver, Colo.	1285	4.327	8.148	0.54	0.0034	40
Detroit, Mich.	1089	3.000	6.983	0.43	0.0028	36
Kansas City, Kan.	960	2.070	4.008	0.52	0.0022	55
Knoxville, Tenn.	972	1.993	4.909	0.41	0.0021	53
Louisville, Ky.	1081	2.720	7.112	0.38	0.0025	30
Miami, Fla.	875	2.024	4.499	0.45	0.0023	48
Montreal, Que.	1200	1.693	6.147	0.28	0.0014	41
Oakland, Calif.	1232	2.490	5.694	0.44	0.0020	59
Oakland, Calif.	1224	3.533	9.425	0.38	0.0029	38
Oakland, Calif.	1220	3.607	6.545	0.55	0.0930	45
Richmond, Va.	1078	2.275	12.842	0.18	0.0021	41
St. Paul, Minn.	1240	4.208	8.246	0.51	0.0034	25
St. Paul, Minn.	1253	3.883	5.301	0.73	0.0031	27
St. Paul, Minn.	1253	4.384	8.246	0.53	0.0035	29
Average				0.44	0.0026	38
Maximum				0.73	0.0035	59
Minimum				0.13	0.0013	17

In the early type, the holes were in the top of the laterals and were equipped with brass strainers of various styles designed to prevent sand from getting into the pipes. This arrangement was expensive and troublesome and was gradually superseded by the present perforated pipe with holes in the lower side of the laterals to direct the wash water downward or at an angle of 30 or 60 degrees from the vertical. In the present type, reliance is placed upon careful grading of the gravel to keep the sand out of the laterals.

In 1920, H. N. Jenks, Assistant Engineer of the Filtration Division of the Sacramento, Calif., Water Department, carried out extensive experiments

TABLE 3A

Filters With Sand Areas of 400 to 800 sq.ft.

CITY	NET SAND AREA PER FILTER	TOTAL AREA OF ALL PERFORATIONS	TOTAL AREA OF ALL LATERALS	RATIO OF AREA OF PERFORATIONS TO AREA OF LATERALS	RATIO OF AREA OF PERFORATIONS TO NET SAND AREA	RATIO OF LENGTH TO DIAMETER OF LATERAL
	sq.ft.	*sq.ft.*	*sq.ft.*			
Austin, Tex.	450	0.736	2.094	0.35	0.0016	24
Austin, Tex.	450	0.662	3.207	0.21	0.0015	27
Bay City, Mich.	700	2.094	4.142	0.51	0.0030	41
Covington, Ky.	560	1.679	4.887	0.34	0.0030	30
Dallas, Tex.	728	1.403	2.750	0.51	0.0019	52
Fort Worth, Tex.	450	1.387	3.207	0.43	0.0031	27
Fort Worth, Tex.	728	1.435	4.800	0.30	0.0020	37
Grand Rapids, Mich.	738	0.933	2.967	0.31	0.0013	27
Great Falls, Mont.	727	1.993	2.454	0.81	0.0027	55
Great Falls, Mont.	540	1.411	2.008	0.70	0.0026	60
Harrisburg, Pa.	432	0.846	1.125	0.75	0.0019	67
Indianapolis, Ind.	721	1.364	3.927	0.35	0.0018	33
Lima, Ohio	480	1.289	3.068	0.42	0.0027	50
Little Rock, Ark.	700	2.108	4.363	0.48	0.0030	42
Macon, Ga.	406	1.102	2.249	0.49	0.0027	36
Oklahoma City, Okla.	696	1.781	2.111	0.84	0.0026	48
Racine, Wis.	525	1.222	2.443	0.50	0.0023	46
Racine, Wis.	700	1.561	3.000	0.52	0.0022	53
Saginaw, Mich.	728	1.981	5.181	0.38	0.0027	34
Sheboygan, Wis.	700	1.932	2.749	0.70	0.0028	44
Sheboygan, Wis.	700	1.552	3.136	0.50	0.0022	53
Wilmington, Del.	728	0.884	4.811	0.18	0.0018	31
Windsor, Ont.	700	1.582	4.328	0.37	0.0023	48
York, Pa.	610	1.364	3.142	0.43	0.0022	45
Average				0.48	0.0023	42
Maximum				0.84	0.0031	67
Minimum				0.18	0.0013	24

to determine the correct hydraulic efficiency of the perforated-pipe underdrain system, with the following conclusions:

1. The ratio of the length of the lateral to its diameter should not exceed 60.

2. The diameter of perforations in the laterals should be between $\frac{1}{4}$ and $\frac{1}{2}$ in.

3. The spacing of the perforations along the lateral may vary from 3 in. for a diameter of perforation of $\frac{1}{4}$ in. to 8 in. for a diameter of perforation of $\frac{1}{2}$ in.

4. The ratio of the total area of the perforations in the underdrain system to the total cross-sectional area of the laterals should not exceed 0.5 for a diameter of perforation of $\frac{1}{2}$ in. and should decrease to 0.25 for a diameter of perforation of $\frac{1}{4}$ in.

TABLE 4A

Filters With Sand Areas of 200 to 400 sq.ft.

CITY	NET SAND AREA PER FILTER	TOTAL AREA OF ALL PERFORATIONS	TOTAL AREA OF ALL LATERALS	RATIO OF AREA OF PERFORATIONS TO AREA OF LATERALS	RATIO OF AREA OF PERFORATIONS TO NET SAND AREA	RATIO OF LENGTH TO DIAMETER OF LATERAL
	sq. ft.	*sq.ft.*	*sq.ft.*			
Alliance, Ohio	352	0.993	3.043	0.33	0.0028	36
Beaumont, Tex.	360	0.307	1.309	0.23	0.0009	49
Birmingham, Ala.	349	0.881	1.781	0.50	0.0025	48
Cheyenne, Wyo.	360	2.226	5.934	0.38	0.0062	24
Columbus, Ga.	384	0.921	2.873	0.32	0.0024	27
Greensboro, N.C.	352	0.859	2.062	0.42	0.0024	31
Hagerstown, Md.	369	0.739	2.475	0.30	0.0020	35
La Porte, Ind.	360	0.386	4.909	0.08	0.0011	19
Lawrence, Mass.	366	0.921	1.767	0.52	0.0025	79
Norfolk, Va.	227	0.160	1.658	0.10	0.0007	32
Port Arthur, Tex.	361	0.945	2.160	0.44	0.0026	38
San Diego, Calif.	254	0.141	1.004	0.14	0.0006	22
Sandusky, Ohio	360	1.104	1.363	0.81	0.0031	38
Springfield, Mo.	370	0.450	2.051	0.22	0.0012	38
Toledo, Ohio	306	0.455	1.920	0.24	0.0015	51
Topeka, Kan.	360	0.982	1.964	0.50	0.0028	32
Winston-Salem, N.C.	360	1.104	3.142	0.35	0.0031	29
Average				0.35	0.0023	37
Maximum				0.81	0.0062	79
Minimum				0.08	0.0006	19

5. The ratio of the total area of the perforations in the underdrain system to the entire filter area may be as low as 0.002.

6. The spacing of the laterals may be as great as 12 in. for satisfactory diffusion but is limited by the total head available.

7. The rate of washing may be varied from 6 to 36 in. per min., provided the foregoing factors are used in the design.

The above ratios are frequently expressed as the "Jenks Ratios" for perforated-pipe underdrain systems; they have been used extensively for the past two decades.

In addition to the experiments carried on by Jenks, reference should also be made to the study and experiments by J. W. Ellms of Cleveland, Ohio, who confirmed to a large extent the investigations of Jenks in Sacramento and also recommended two additional ratios, noted below:

1. The sum of the cross-sectional areas of the laterals should be at least twice the sum of the cross-sectional areas of the perforations in the laterals.

2. The area of the manifolds feeding the laterals should be from 1.75 to 2.00 times the sum of the cross-sectional areas of the laterals which are fed in the washing process.

TABLE 5

Summary of Tables 1A–4A

RATIOS		TABLE 1A	TABLE 2A	TABLE 3A	TABLE 4A	SUMMARY	RATIOS (H. N. JENKS)
Ratio of Length to Diameter of Laterals	Avg.	37	38	42	37	39	Should not exceed 60
	Max.	59	59	67	79	79	
	Min.	22	17	24	19	17	
Ratio of Area of Perforations to Area of Laterals	Avg.	0.45	0.47	0.44	0.31	0.44	Not more than 0.50 for ½ in. holes, reducing to 0.25 for ¼ in. holes*
	Max.	0.84	0.75	0.84	0.52	0.92	
	Min.	0.23	0.13	0.18	0.08	0.08	
Ratio of Area of Perforations to Net Sand Area	Avg.	0.0027	0.0030	0.0023	0.0023	0.0026	Should not be less than 0.0020
	Max.	0.0066	0.0080	0.0031	0.0062	0.0080	
	Min.	0.0012	0.0013	0.0013	0.0006	0.0006	

* Ellms recommends that this ratio be "*not less than 0.50*" which is considered a much safer practice.

The studies made by Ellms also indicated the practicability of employing only one manifold for both halves of the filter and placing it under the center gutter, thus allowing the use of laterals of sufficient length to extend across each half of the filter. This type of design has gained rapidly in popularity within the last ten years.

Using the basic data from the questionnaires given by the cities, it is possible to compute the "Jenks Ratios" in each specific case and to observe exactly how close the various water works engineers have come to an agreement on the hydraulic factors involved in the design of perforated-pipe underdrains. For the purpose of better comparison, these computations have been divided into four tables—1A, 2A, 3A and 4A—representing the various sizes of filters. A summary is presented in Table 5.

It is shown clearly by these calculated ratios and the summary table that the rules for design of perforated-pipe underdrain systems recommended by Jenks in 1920 and confirmed by Ellms in 1927, with certain modifications, have been followed by a large majority of the users of this type of underdrain in the United States and Canada. That the procedure has been uniformly successful indicates it to be a safe one for general practice.

In addition to the data on hydraulic design of perforated-pipe underdrains presented in the above discussion, a number of other valuable sidelights have been brought out by analysis of the answers given in the questionnaire and from other sources, which are discussed in the following paragraphs.

To what extent are perforated-pipe underdrains used on rapid sand filter plants throughout the United States?

In order to answer this question, an analysis was made of all the cities of the United States with populations in excess of 50,000 and the following summary was obtained:

Cities in the United States with populations over 50,000	192
Number of above cities with rapid sand filter plants	91
Number with perforated-pipe underdrains	69
Number with all other types of underdrains	22
Ratio of Item 3 to Item 4	3 to 1

This tabulation shows clearly that, up to the present time, the perforated-pipe type of underdrain is given preference above all other types combined in a ratio of about 3 to 1.

Would you change to some other type of underdrain than the perforated-pipe if you should build new filters?

There is an old saying that "the proof of the pudding is in the eating" and the purpose of the above question was to obtain an unbiased vote on the success or lack of success of each of the water works engineers with perforated-pipe underdrains from their own personal experience. The detailed replies given in the questionnaire are most interesting and it is to be regretted that they cannot be given in full in this brief discussion. The following, however, is a paraphrased summary:

1. Would not change	32
2. Would change	12
3. Questionable: Think not	8
4. Questionable: Think yes	5
5. Questionable: Would study further	3
6. No answer	5
	65

The favorable votes may be considered as Item 1 plus Item 3 plus one-half of the sum of Items 5 and 6, or a total of 44. The unfavorable votes may be considered as Item 2 plus Item 4 plus one-half of Items 5 and 6, or 21. The final vote, then, is as follows: favorable, 44, or 68 per cent; and unfavorable, 21, or 32 per cent. This is a ratio of 2 to 1 for continuation of the use of perforated-pipe underdrain systems, which is a fairly safe majority. On the other hand, the unfavorable votes are by no means to be overlooked and it is easily possible that improvements can be made.

Is your filter sand clean enough to suit you?

The question was purposely worded in this manner, as it was realized that the cleanliness of filter sand has a more or less personal viewpoint and the answers are indicative to a certain extent of the efficiency of perforated pipe underdrains. The vote is as follows: Yes, 44; and No, 11. This is an easy majority of 4 to 1.

Is surface washing used, either hand or mechanical?

Surface wash is a new factor in the operation of rapid sand filters, at least renewed in popularity, and a great many filter plant operators are now interested in this subject; whereas, two years ago, when the questionnaire was sent out, the subject was just on the threshold of its revival. Answers received were as follows:

None	45
Intermittent hose wash or agitation with rakes	15
Fixed surface wash	5

On the face of the replies, no great interest in surface wash is indicated, but, if this same question were asked today rather than in October 1939, when the questionnaire was sent out, it is felt that the replies would show a very decided increase in interest in surface wash. It is now realized that surface wash should be included in new filter plant designs.

Is air agitation used?

The vote on this question leaves very little room for argument, being as follows: Yes, 4; and No, 61. This indicates quite definitely that air agitation need not be considered for any new filter plant design.

Do you consider high-velocity wash an important factor in keeping filter sand clean?

This is one of the controversial questions among water works engineers today and the vote which follows should be most interesting:

Yes	47
No	15
Prefer lower wash rate with surface wash	7
Medium rate preferred	4
No answer	2

The advocates of high-velocity wash have an easy majority of about 2 to 1, which should be taken as an indication that high-velocity wash must definitely be considered as one of the factors in designing new filtration plants. At the same time, it would be well to keep in mind the vote of seven counts of those who prefer the lower wash rate with surface agitation. It is believed that in the majority of cases, depending upon plant layout, a good type of surface agitation will permit the use of lower wash rates with resultant economy. Even in cases where a new plant is designed, however, it would be desirable, in view of the relatively small increase in total cost involved, to provide for high-velocity wash as operating conditions might easily obtain in which it would prove beneficial.

The above method of analyzing the opinions of users of the perforated-pipe type of filter underdrain, as presented by the questionnaire, was used and the following is a general summary:

(1) The ratios for hydraulic design of perforated-pipe underdrains as recommended by Jenks and confirmed and extended by Ellms have proved satisfactory and may be used with assurance for good results in future designs.

(2) Provision of surface wash for filters should be included in new filter installations or in revision of existing filters.

(3) High-velocity wash is considered by the majority to be an important factor in keeping filter sand clean, but only a few plants are equipped for it. Provision should be made for its use in new plants.

(4) All types of filter underdrains should be made of non-corrosive materials. The majority of users of the perforated-pipe type prefer cement-lined, cast-iron pipe with brass eyelets for this purpose. Use of straight, non-staggered holes is preferred by a small majority. A few notes on the use of cement-asbestos pipe underdrains were also received, but not enough experience with this material was shown to draw any conclusions.

(5) Short laterals, approximately 5 to 7 ft. in length, predominate in all groups but the more modern installations have shown a trend toward greater lengths, up to 12 or 14 ft.

(6) The larger filters favor a perforated-pipe diameter of 3 to 4 in. and a spacing of from 8 to 12 in. The smaller filters favor the use of 2-in. laterals and a spacing of 6 in. The modern trend seems to be toward the larger diameters and a maximum spacing of about 12 in.

(7) The center location of the main wash-water gullet is preferred in the larger filters and the front position, in the smaller filters. The side location of the main gullet has few adherents.

(8) The advocates of air agitation are less than 10 per cent of the total, indicating that this process may be considered to have lost its popularity.

(9) The original rating of approximately 125 mgd. per acre for rapid sand filters has been followed with a surprising degree of uniformity in a large majority of the plants, indicating that this criterion should be continued.

(10) The fact that most plants were constructed without high-velocity wash and the consequent inability of operators to ascertain whether or not it would prove beneficial undoubtedly is responsible for answers indicating lack of direct knowledge regarding its use. It is significant to note that most of the more modern plants provide for high-velocity wash.

(11) Perforated-pipe underdrains for rapid sand filters have proved to be satisfactory in a large majority of filter plants throughout the United States and Canada in modern as well as in early installations, so that the continued use of this type may safely be anticipated. The vote shows, however, that there is still room for improvement.

When the Dalecarlia 80-mgd. rapid sand filter plant at Washington, D.C., was constructed twelve years ago, decision was made to use underdrains of the open, wood-slat type. Results from its use later proved unsatisfactory. In 1939, the condition of the filters was so serious that funds were obtained to modify the underdrains and to eliminate the wood slats. Consequently, studies were initiated to determine the type to be used. As a direct result of the answers to the questions and the detailed information furnished by the questionnaire, decision was made to adopt the cast-iron perforated-pipe type for all replacement work. Cement-lined cast-iron pipe will be used in subsequent underdrain replacements.

As an experiment, two of the new perforated-pipe underdrains at Dalecarlia were made with cement-asbestos pipe in place of cement-coated cast-iron pipe, but these filters have been in use only one year so that the writers hesitate to give an opinion at this time regarding its use. It is believed, however, that cement-asbestos pipe may eventually prove, in many respects, to be a strong competitor of other materials for perforated-pipe underdrains.

As another result of the questionnaire, decision has been made by the United States Engineer Office at Washington, D.C., to use high-velocity wash as well as surface wash for all new filters at Dalecarlia.

A final note of explanation regarding the omission of certain cities from the tabulations is in order. This was done for several reasons but princi-

pally because of the decision to limit the scope of the comparison entirely to filter plants equipped with perforated-pipe underdrains.

Appreciation is again expressed to the many water works officials who were so co-operative in supplying the data and to E. A. Hardin, Engineer of Design of Filtration Plants, Philadelphia, Pa., for his able assistance in the compilation.

Discussion by *E. A. Hardin*.* The undertaking of Mr. Schmitt and Mr. Macqueen, to collect some tangible experience data on perforated-pipe underdrains used in rapid sand filters over the country, is very commendable indeed. There have been some differences of opinion as to the proper materials and design of filter bottoms, due possibly to varied experience. This compilation is of value in its contribution of details of basic practice and broader actual experience. It is hard to beat an assembly of unbiased reports from a large number of plant operators, such as this survey or poll brought out and now presents for all to draw their own conclusions. It appears that the case of the perforated pipe stands up very well under this searching review of experience.

It is noteworthy that in most of the cases where the perforated-pipe underdrain system has not been fully satisfactory either the diameters of the perforations are too small or the ratio of area of perforations to filter area is too small. In some cases trouble has been found with too small pipe laterals, particularly if the water was corrosive or encrustant.

This writer has seen small laterals almost completely filled with tubercles and incrustation, and he has seen small perforations clogged in some cases or corroded into odd shapes in others. It appears that difficulties may be expected with perforations of $\frac{1}{4}$ in. or smaller and with laterals $1\frac{1}{2}$ in. or smaller. Proper design will, in general, avoid trouble by remaining within the conservative limiting ratios deteımined by Mr. Jenks and verified by Mr. Ellms and others, and very satisfactory filters may be had with perforated-pipe underdrains.

The writer's tendency has been toward the use of larger pipe, larger perforations, and the larger ratios of perforation area to sand area. Tests on laterals at Detroit, made in 1931, indicated that holes up to $\frac{5}{8}$ in. in diameter, spaced 6 in. center to center, in 4-in. laterals 13 ft. long, would be satisfactory. The more conservative $\frac{1}{2}$-in. holes, however, were adopted. It should be pointed out in this connection, that the bushings used in the Detroit underdrains were made from extra-heavy $\frac{1}{2}$-in. brass pipe, which has a clear diameter of 0.54 in. If this actual size is taken instead of the nominal $\frac{1}{2}$-in., the hole area becomes 0.229 sq.in. instead of 0.196 sq.in. per hole, and total hole area per filter becomes 3.5 sq.ft. instead of 3.0 sq.ft., thus raising the ratios accordingly to 0.5 for ratio of hole area to lateral area

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and 0.0032 for ratio of hole area to sand area. Recent tests, made in Philadelphia with a superior arrangement of apparatus, confirm the satisfactory hydraulic action of the larger holes, and it is intended to extend these tests to determine the limit of hole size for satisfactorily uniform distribution of wash water discharge.

Other tests have shown the definite advantage of bushings or eyelets in the perforations to obtain uniformity of discharge from the holes themselves. Careful calibration of holes and measurements of water discharge rates from the holes indicate that there is likely to be considerable variation in the holes themselves. The most careful workmanship and care in obtaining uniform perforations is definitely a prime requisite for a satisfactory perforated-pipe underdrain system unless one is to depend on chance and the averaging up of random errors.

It is interesting also to note that the theoretical and observed increase in discharge along the perforated laterals due to the gradual increase in pressure from the velocity head regain has not been reported as detrimental in the operation of filters. There is in fact some possibility that more wash water at the side walls is beneficial in avoiding sand caking along the walls or pulling away from the walls. Therefore, what has been considered a defect in the perforated-pipe underdrain system may possibly have been a virtue. Some designers have used additional perforations in laterals adjacent to walls. At Detroit a header was run along each side of the filters to which were connected the ends of the laterals and these headers were perforated to give additional wash water discharge at the walls. The favorable operation of these filters speaks for itself.

The use of asbestos-cement pipe, where satisfactory metal pipe is unobtainable or where the water is seriously corrosive, is a definite possibility. Comparative tests recently made at Philadelphia have shown the hydraulic characteristics of perforated asbestos-cement pipe underdrain laterals to be reasonably equal to perforated cast-iron pipe laterals. The desirability of eyelets or bushings in the holes is again indicated in this type of pipe to assure both initial uniformity of the perforations and this uniformity maintenance of over years of use.

In closing, this writer wishes to bring out the fact that there are many different designs and details of filter underdrain systems in satisfactory use. Availability of materials, character of water, cost comparisons, and other factors may indicate the greater desirability of one type in a certain plant and another type in other plants. Thus, the designer will still have to determine for himself what type or design and materials best suits his conditions. It is helpful and reassuring to know, however, that a typical cross-section of experience, as portrayed in this paper, indicates the acceptability of a properly designed perforated-pipe filter underdrain system and that it may safely be used wherever the above determining factors favor it.

Accuracy and Application of Threshold Odor Tests

By Charles H. Spaulding

ODORS can be measured and odor removal processes evaluated directly by odor measurement. The undertaking involves several inherent difficulties which have not always been recognized, including the variable responses of individuals to identical stimuli. In this paper will be shown the extent to which these difficulties can be overcome and to which reproducible comparative results which are not dependent on the individual, can be obtained. Further will it be shown how these comparative results can be applied to the evaluation of activated carbons or other materials and methods of odor removal.

One mistake to avoid in the approach to threshold odor accuracy is to overreach the essential objective. Such concepts as "absolute values," represented by the "olfacty" or any other unit, are non-essential. The quality of an odor also introduces vast complications which can and must be ignored at the start. In other words, the first and only essential of comparative odor measurement is a positive response to equal minimal amounts of the same or similar odors within the briefest possible period of time. Reduced to simplest terms, correct comparisons of odors depend upon the equality of parallel thresholds, and errors are deviations from equality.

Another pitfall of odor measurement is in mathematical interpretation. Several simple rules are needed:

1. Every odor measure is a comparison of two or more specimens.

2. Two or more values of the same odor are equally valid if the same technic has been used and no other changes have occurred (explained below).

3. The threshold odor (T.O.) shown by one dilution of a solution has as much validity as any other, including a 100 per cent portion, providing no changes have occurred in preparation.

A contribution by Charles H. Spaulding, Supervising Chemist, Dept. of Water, Light & Power, Springfield, Ill.

A mathematical fact which should not be overlooked is that in the comparison of two quantities, both subject to error, the error of the ratio may be greatly magnified. Assuming that O_1 has an error percentage of r_1 and O_2 has an error percentage of r_2, the ratio (V) found will be:

$$V = \frac{O_1 + r_1 O_1}{O_2 + r_2 O_2} = \frac{O_1(1 + r_1)}{O_2(1 + r_2)} \qquad (1)$$

It will be seen that the ratio will be exactly correct whenever $r_1 = r_2$ and has the same sign; but if one is positive and the other negative the effect may be disastrous. Thus, for a 20-per cent error of opposite sign, $\frac{1 + r_1}{1 + r_2} = \frac{1.2}{0.8}$ or $\frac{0.8}{1.2}$. In this case the correct ratio will be upset by a factor which may raise it 50 per cent or lower it 33 per cent. It is obviously essential to prevent such occurrences.

There is no odor value except that conferred by the observer, which is a purely subjective one. Accuracy in odor measurement means consistency, i.e. an accurate measurement is one which agrees with the average of all similar measurements of the same specimen in the same comparison. When thus defined the accuracy is based on the deviation from the average value and this average includes the last as well as all other measurements.

Rule 1 limits the measurement to the comparative purpose for which it is designed, each set of parallel tests standing as a unit. A value obtained in such a comparison cannot be removed and used independently in some other comparison. The significance of this rule will appear later. It may be pointed out here, however, that odor values of single samples are not useful for close comparisons.

Rules 2 and 3 may best be explained by examples:

Rule 2: An observer measures the odor of three identical samples of a water and finds the values 8, 10 and 12. In this case, the average T.O. is 10. The first observation was 20 per cent low, the second correct and the last 20 per cent high. Since the three samples were run in parallel, they show the observer's accuracy. If no other sample was included at the same time the determination has significance only as an accuracy test.

Rule 3: An observer measures the odor of three known dilutions of the same water, e.g., 20, 40, and 100 per cent, and obtains the values 1.6, 4.8 and 10. After compensating for dilution, the values shown for the undiluted water are 8, 12 and 10. Again the average is 10. The T.O. of the first dilution is 20 per cent low, the second is 20 per cent high and the last is correct, not because it happened to be an undiluted sample, but because it agrees with the average. Again the value 10 has no significance by itself—it cannot be filed away as the T.O. of this specimen.

If any comparison with other specimens is to be made the odors of both or all will have to be made in parallel, i.e., at the same time, alternating from one to another at random. When this is done the important consideration will be the relative values of the two or more specimens under test. *A* may be 10 and *B*, 20, or *A* may be 50 and *B*, 100. Failure to obtain a fixed ratio between *A* and *B* within the limits of reasonable error constitutes a failure of measurement.

Odor Technic

The term "parallel" as used here means that the several samples under examination were diluted alternately and submitted to the observer immediately after dilution without identification or opportunity for identification. The threshold of the several samples is arrived at by a system of narrowing dilution in such a way that the tests on all samples are completed at about the same time. This system is advisable not merely to protect against drifting sensitivity but also to eliminate bias, conscious or unconscious, since by this means both diluter and observer may be kept entirely unaware of the identity of the sample as well as of the dilution.

Another necessary precaution is to ascertain whether the observer is qualified physically and temperamentally for such work. The ability to observe odors consistently is in no sense a measure of intelligence, for it depends largely on little understood physiological factors. It is needless to speculate on what sort of reflexes are required, however, since the qualifications of the observer can be shown by tests of known samples submitted without identification.

Qualifying Tests of Observer

The entire personnel of the Springfield water purification plant has been tested for odor measurement. Of eight men, three are well qualified, one is only fair, two are unsatisfactory, and the remaining two are apparently satisfactory but have had few trials.

The records of the first six are submitted for study in Table 1, which shows *all* of the tests made by these observers on known duplicates or dilutions between the dates given. It will be noted that the table shows not only the T.O. assigned to each sample but also the positive or negative response by the observer to each dilution. The dilution interval of the dilution table employed is approximately 10 per cent of the mean of the two adjacent dilutions, hence it is possible to transpose graphically all values to a common threshold. In the ideal test all dilutions to the left of the threshold will be negative while all to the right will be positive. The positive responses are indicated by an x, the negatives by an o and

TABLE 1

Qualifying Tests of Consistency of Observers

Date	Source	Dilution	T.O. Found	T.O. Calculated	Percentage Deviation	Negative Dilutions*	Common Threshold	Positive Dilutions*
Observer A								
12-29-40	Raw	1.0	6.9	6.9	−9	o....oo		xx..x
	Raw	1.0	5.7	5.7	−25	o....oox		oxxx
	Raw	1.0	10.2	10.2	+34	ooxx		oxxoxxx..x
12-31-40	Tap	1.0	3.6	3.6	+42	..o..oo		xx
	Tap	1.0	2.0	2.0	−21	o.....ooooo		xx
	Tap	1.0	2.0	2.0	−21	o....ooxo..		oxx
1- 1-41	Tap	1.0	1.6	1.6	−16	o.....o....oo		xx...x
	Tap	1.0	2.9	2.9	+53	.............oo		xx...x
	Tap	1.0	1.2	1.2	+37	.............ooxo		oxx
1- 8-41	Raw	0.50	3.6	7.2	+42	o.....oooxx		oxoxx..x
	Raw	1.00	3.2	3.2	−37	o.....oo.oox		oxx...x
	Raw	0.75	3.6	4.8	+5	o.....ooooo		xx
1-23-41	Tap	1.00	—	—	—	o.......................		
	Raw	1.00	—	2.4	—	o.....oo.ooxoxo		xooxx
	Tap	0.50	—	—	—	o.....o.....o.....o.... o		
Observer B								
12-27-40	Raw	1.00	4.8	4.8	−44	o.....o.....o..oo		xx
	Raw	0.75	3.2	4.3	−50	o.o.x.....o.....ooo		xx.x
	Raw	0.50	8.4	16.8	+94	o.....o..oo		xx
1- 1-41	Tap	1.00	2.2	2.2	+3	x		oxx
	Tap	1.00	1.8	1.8	−16	o.....o.....oo..oo		xx
	Tap	1.00	2.4	2.4	+13	o.....o.....oox		xoxx
1- 6-41	Tap	0.50	2.2	4.4	+11	..................ooxo		.xx
	Tap	1.00	3.6	3.6	−9	o.....o.....oooox		oxx
	Tap	0.75	2.9	3.9	−2	o.....o.....oo..oox		oxx
1- 7-41	Tap	1.00	3.9	3.9	+5	o.....o.....oooo		xxx
	Tap	.50	2.0	4.0	+8	o.....o.....o.....oooxx		oxoxx
	Tap	.75	2.4	3.2	−13	o.....o.....o.....oox		oxxx
1- 8-41	Tap	0.75	3.6	4.8	−11	o.....o.....oooox		oxx
	Tap	1.00	3.6	3.6	−33	o.....o.....oooxo		xoxx...x
	Tap	0.50	3.9	7.8	+44	o.....oo..ooxoooo		oxx
1-20-41	Raw	1.00	5.2	5.2	−14	o....oo		xx...x
	Tap	1.00	2.0	—	—	o.....o.....ooooo		xx
	Raw	1.00	6.9	6.9	+14	ooxoo		oxx

* Key: o = Negative observation; Period (.) = Untested dilution; x = Positive observation.

TABLE 1—*Continued*

DATE	SOURCE	DILUTION	T.O. FOUND	T.O. CALCULATED	PERCENTAGE DEVIATION	NEGATIVE DILUTIONS*	COMMON THRESHOLD	POSITIVE DILUTIONS*
Observer C								
12- 6-40	Filter	1.00	5.0	5.0	+6.4	o.....o....oo		xxx..x
	Raw	1.00	10.0	10.0	—	ooox		xxoxx.x
	Filter	0.80	3.5	4.4	−6.4	o.....o.....o..ooo		xx
12-10-40	Filter	1.00	7.5	7.5		o..ooo		xx
	Raw	1.00	23.0	23.0	+18.0	ooo		xx....x
	Raw	0.50	16.5	33.0	−18.0	o..o.oo		xxx
12-18-40	Filter	0.70	3.0	4.3	+16.0	o.....o..ooo		xx
	Filter	1.00	3.4	3.4	−8.0	o.....o.oox		oxx
	Filter	1.00	3.4	3.4	−8.0	o.....o..oo		xx
1- 8-41	Tap	0.50	4.8	9.6	−2.0	o.....oo		xx.xx
	Tap	0.75	5.7	7.6	−22.0	oo.oox		oxx...x
	Tap	1.00	12.3	12.3	+25.0	ooxo		xxoxx...x
1-27-41	Raw	0.70	2.2	3.1	−29.0	....................ooxo		oxx
	Raw	0.40	—	—	—	o.....o.....o.....o.....o.		
	Raw	0.85	4.8	5.6	+29.0	o.....o.....oo		xx.xx
1-31-41	Tap	0.75	5.2	7.0	+1.0	o....oo		xx...x
	Tap	1.00	4.8	4.8	−30.0	o.....oo		xx.xx
	Tap	0.85	7.6	8.9	+29.0	............oxo		oxxoxx
2- 1-41	Tap	1.00	3.6	3.6	+13.0	o....ooxoxox		oxooxxx
	Tap	1.00	3.2	3.2	+1.0	o....ooooxxo		xooxxx
	Tap	1.00	2.7	2.7	−14.0	o.....o....oox		xxoxx
Observer D								
12- 9-40	Raw	1.00	10	—	—	oox		oxx.x
	Cond.†	0.50	3.5	7.0	−4	o.....o....ooo		xxx
	Cond.	1.00	7.5	7.5	+4	o.ooo		xx
12-10-40	Filter	1.00	2.3	—	—	o.....o.....oooxo		oxx
	Raw	1.00	11.0	11.0	+10	ooo		xx.x
	Raw	0.50	4.5	9.0	−10	o.....o.....oo		xx..x
12-17-40	Tap	1.00	2.0	2.0	−31	o.....o.....o...o.oo		xxx
	Tap	0.50	1.5	3.0	+3	o.....o.....o.....o.oo		xxx
	Tap	1.00	3.7	3.7	+28	o.....o....oo		xxx..x

† Sample of lake water which has passed through turbine condenser; similar to, but not identical with, raw water.

TABLE 1—*Continued*

DATE	SOURCE	DILUTION	T.O. FOUND	T.O. CALCULATED	PERCENTAGE DEVIATION	NEGATIVE DILUTIONS*	COMMON THRESHOLD	POSITIVE DILUTIONS*
				Observer D—Continued				
12-18-40	Tap	0.60	1.27	2.1	+1	o.....o.....o..ooo		xx
	Tap	1.00	2.00	2.0	−3	o.....o.....oo		xxx..x
	Tap	0.50	1.05	2.1	+1	o.....o.....o.....oo		xx
12-19-40	Tap	1.00	2.1	2.1	−16	o.....o..o.ox		oxx
	Tap	0.60	1.4	2.3	−8	o.....o.....o.oox		xoxxx
	Tap	0.40	1.25	3.1	+24	o.....o.....o..ooo		xx
12-23-40	Raw	1.00	2.2	—	—	oox		x.xox.x..x
	Filter	0.50	—	—	—	o.....o..o..o		
	Filter	1.00	1.8	—	—	o..oox		oxxx..x
1- 2-41	Filter	1.00	2.2	2.2	−6	o.....oo...oxooo		oxx
	Filter	1.00	2.4	2.4	+3	o.....o.....ooo		xxxx
	Filter	1.00	2.4	2.4	+3	o.....o.....oox		oxxx
1- 4-41	Tap	0.80	2.4	3.0	+7	o.....o.....oox		oxxx
	Tap	0.60	1.5	2.5	−11	o.....o.....o.....oo		xx.xx
	Tap	1.00	2.9	2.9	+4	o.....o....oo		xx...x
1- 7-41	Tap	0.75	1.8	2.4	+12	o.....o.....o.....oo..oo		xx
	Tap	1.00	1.8	1.8	−15	o.....o.....oo..oo		xx
	Tap	0.50	1.1	2.2	+3	o.....o.....o....ooxoooo		x
1-27-41	Raw	0.40	—	—	—	o.....o.....o......$\overset{o}{o}$		
	Raw	0.70	1.2	1.7	−17	o.....o.....ooxx		$xo\overset{x}{o}$
	Raw	0.85	2.0	2.4	+17	o.....oooox		oxx
1-31-41	Tap	1.00	2.0	2.0	−28	o.....o.oox		xox....x
	Tap	0.85	2.7	3.2	+14	o.....oo		x.xx
	Tap	0.75	2.4	3.2	+14	o.....ooo		xxxx
				Observer E				
1- 3-41	Tap	0.80	4.8	6.0	+31	o.....x.....oo		xx.xx
	Tap	1.00	3.2	3.2	−30	o...oo		xx
	Tap	0.60	2.7	4.5	−1	o.....o.....oo		xxxx
1- 4-41	Tap	0.50	1.4	2.8	±0	o.....o.....o.....ooo		xxxx
	Tap	0.75	1.8	2.4	−14	o.....o.....o.....oo..oo		xx
	Tap	1.00	3.2	3.2	+14	o.....o.....oo..oo		xx

TABLE 1—*Continued*

DATE	SOURCE	DILUTION	T.O. FOUND	T.O. CALCULATED	PERCENTAGE DEVIATION	NEGATIVE DILUTIONS*	COMMON THRESHOLD	POSITIVE DILUTIONS*
				Observer E—*Continued*				
1- 6-41	Tap	0.75	1.4	1.86	+7	o.....o.....o.....oox		oxxx
	Tap	0.50				o.....o.....o.....o.....o o		
	Tap	1.00	1.6	1.60	−7	o.....o.....o......oo..ox		oxx
1- 7-41	Raw	0.60	7.6	12.7	−6	ooxx		xoxoxx...x
	Raw	1.00	13.5	13.5	±0	oox		xxxoxx...x
	Raw	0.30	4.3	14.3	+6	oox		xxoxx
1-27-41	Tap	0.58	—	—	—	o.....o.....o....oo		x o
	Tap	0.70	1.0	1.4	+5	o.....o.....o....oo		o x x
	Tap	0.80	1.0	1.3	−5	oo..oo		x x x
2- 7-41	Tap	1.00	1.0	1.0	±0	o.....ooo		xxxx
	Raw	1.00	2.7	2.7		oo		xxxx
	Tap	1.00	1.0	1.0	±0	o.....ooo		xxxx
2- 5-41	Tap	1.00	1.2	1.2	±0	o.....o.....oooo		xxx
	Raw	1.00	2.0	2.0		o.....ooooo		xx
	Tap	1.00	1.2	1.2	±0	o.....o.....ooox		xoxx
1-31-41	Tap	0.90	2.2	2.4	+22	oooo		xxx
	Tap	1.00	1.5	1.5	−24	o.....o.....oo		xxxx
	Tap	0.80	1.6	2.0	+2	oo..oox		oxx
				Observer F				
12-28-40	Raw	1.00	5.2	5.2	±0	oo		xxx..x
	Raw	1.00	5.2	5.2	±0	oo		xxx..x
	Raw	1.00	5.2	5.2	±0	ooxo		xoxx.x
12-30-40	Tap	1.0	2.7	2.7	+7	o.....oo		xx..x
	Tap	1.00	2.2	2.2	−13	o.....o.oo		xxx
	Tap	1.00	2.7	2.7	+7	o.....oo		xx..x
1- 2-41	Tap	0.67	2.4	3.6	+13	o.....oo..oo		xx
	Tap	0.80	2.7	3.4	+5	o.....oooox		oxx
	Tap	1.00	2.7	2.7	−19	o.....oooox		xoxx...x

TABLE 1—*Concluded*

DATE	SOURCE	DILUTION	T.O. FOUND	T.O. CALCULATED	PERCENTAGE DEVIATION	NEGATIVE DILUTIONS*	COMMON THRESHOLD	POSITIVE DILUTIONS*
Observer F—*Continued*								
1- 3-41	Tap	0.50	1.6	3.2	−17	o.....o.....o.....oo		xx...x
	Tap	1.00	5.2	5.2	+34	o....oo		xx...x
	Tap	.75	2.4	3.2	−17	o.....o....oox		oxxx
1- 3-41	Tap	0.80	1.5	1.9	+3	oo		xx.xx
	Tap	1.00	1.8	1.8	−1	o.....o..oox		oxx...x
	Tap	0.60	1.1	1.8	−1	o.....o.....o....ooxo..		o xx
1- 7-41	Raw	0.30	1.6	5.3	+6	o.....o.....o.....o....oo		xx...x
	Raw	0.60	2.7	4.5	−10	o.....o.....o....oox		oxx.x
	Raw	1.00	5.2	5.2	+4	o.....o....o		xx...x
1- 8-41	Raw	1.00	5.2	5.2	−13	o.....o.....o		xxx..x
	Raw	0.75	4.8	6.4	+7	o.....o....oox		oxxxx
	Raw	0.50	3.2	6.4	+7	o.....oo..oo		xx
1- 9-41	Tap	0.75	2.2	2.9	−10	o.....o.....o.....oooo		xxx
	Tap	1.00	3.2	3.2	−1	oox		oxx...x
	Tap	0.60	2.2	3.6	+11	o.....o.....o.....oooo		xxx
1- 9-41	Raw	0.80	6.9	8.6	+1	o.....o.....oooo		xxx
	Raw	0.40	3.2	8.0	−6	o.....o.....o.....oo..oo		xx
	Raw	0.20	1.8	9.0	+5	o.....o.....o.....oo..oo		xx
1-13-41	Raw	1.00	24.0	24.0	—	o.....ooo		xxxx
	Tap	1.00	3.9	3.9	−5	o.....ooooo		xx
	Tap	1.00	3.9	3.9	+5	o.....ooxo		oxx
1-14-41	Raw	0.20	—	—	—	o.....o.....o.....o.....		o o
	Raw	0.40	1.6	4.0	—	o.....o.....o.....o....oo		xx...x
	Tap	1.00	2.9	2.9	—	o.....o.....o....oo		xx...x
1-15-41	Raw	1.00	22.0	22.0	+13	o.....o.ox		oxx....x
	Raw	0.50	8.4	16.8	−13	oo		xx.xx
	Tap	1.00	2.2	2.2	—	o.....o.....oooo		xxx....x
1-16-41	Raw	1.00	2.7	2.7	+6	o.....oo		xx.xx
	Raw	0.50	1.2	2.4	−6	o.....o.....o.....oooo		xxx
	Tap	1.00	3.9	2.9	—	.....o.....oooo		xxx

untested dilutions by a period. The record therefore contains every positive and negative response, every dilution submitted, as well as all irregularities and incomplete tests.

The ability of each observer is indicated in two ways: (1) by the absence of anomalous responses, i.e., positives to the left or negatives to the right of the threshold, and (2) by the more important criterion of the threshold agreement of identical samples or diluted samples after compensation for dilution. The tables show the values found, the values corrected for

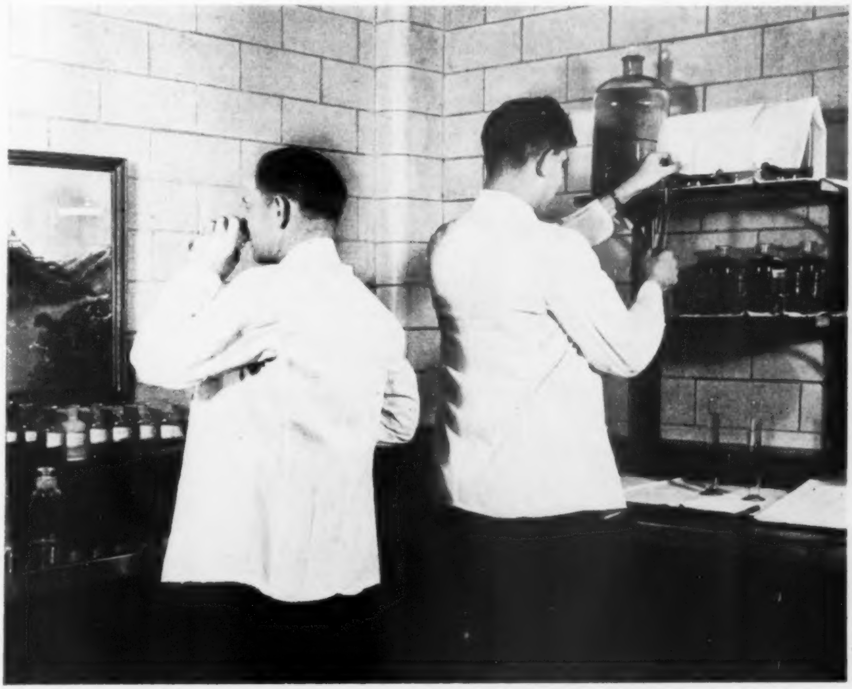

FIG. 1. Test equipment; showing position of operators

dilution, and the percentage deviation of each from the average. Table 2 summarizes the record of each observer. In the table the correlation of average or standard deviations with the ratio of anomalous positives is apparent. It could hardly be otherwise, because the deviations are in fact the results of false thresholds derived from anomalous positives, i.e., positives which would have been above negative values at lower dilutions if sufficient sampling had been done. It is believed that any one of these observers can reduce the deviation of his measurements below the dilution increment by sufficient sampling. The advantage enjoyed by the

observer whose threshold level is constant is one of time and labor saving (see Fig. 3 for specimen work sheets of observers E and F).

Observers D, E and F were much more consistent than A, B or C, but it was frequently necessary to use observer C, because D, E and F were not always available. Most of the tests reported at this time have been made by C, D, E and F, although a few results by two others, without qualifying records, will be encountered. It should be stated that the tests shown in Table 1 were strictly blindfold. Many groups include two

TABLE 2

Qualification of Observers

OBSERVER	AVERAGE DEVIATION	STANDARD DEVIATION	RATIO OF ANOMALOUS POSITIVES TO NO. OF SAMPLES
A	28.5	31.8	10/13
B	22.6	32.2	12/18
C	15.3	18.3	12/21
D	11.0	14.1	13/31
E	8.7	13.3	8/23
F	8.1	10.6	11/38

TABLE 3

Deviations in Qualification Tests of Observers

	MINUS				−3.4 +3.4	PLUS				
	24.5 31.4	17.5 24.4	10.5 17.4	3.5 10.4		3.5 10.4	10.5 17.4	17.5 24.4	24.5 31.4	31.5 38.4
All Samples:										
No. of Deviations	5	4	11	15	26	18	10	3	5	1
Percentage Deviation	5.1	4.1	11.2	15.3	26.5	18.4	10.2	3.1	5.1	1.0
Undiluted Samples:										
No. of Deviations	1	0	2	2	12	3	1	0	1	0
Percentage Deviation	4.5	0.0	9.1	9.1	54.6	13.7	4.5	0.0	4.5	0.0
Diluted Samples:										
No. of Deviations	5	4	9	13	16	15	9	3	5	1
Percentage Deviation	6.2	5.0	11.2	16.3	20.0	18.8	11.2	3.8	6.2	1.3

samples from the same source and one from a different source; the odd sample in such cases is not a direct measure of consistency or accuracy, but it does show plainly the ability of the tester to discriminate. The diluter was in complete ignorance as to whether all three samples were the same or different as to dilution or source. When two or more tests were made on one set of samples the bottles were rearranged for the next diluter. The sample bottles used were aspirator bottles with glass fittings, covered with a towel to prevent identification.

In view of the precautions taken against prejudice, it is worth noting that the agreement among samples of varying dilutions was not as close as when no preliminary dilution was employed. This is shown definitely by the probability curves which can be plotted from the deviations taken from the records of observers C–F. Tabulations of the deviations are shown in Table 3.

It is significant that the highest accuracy is made with undiluted samples; and it may also be significant that the greatest deviations occurred

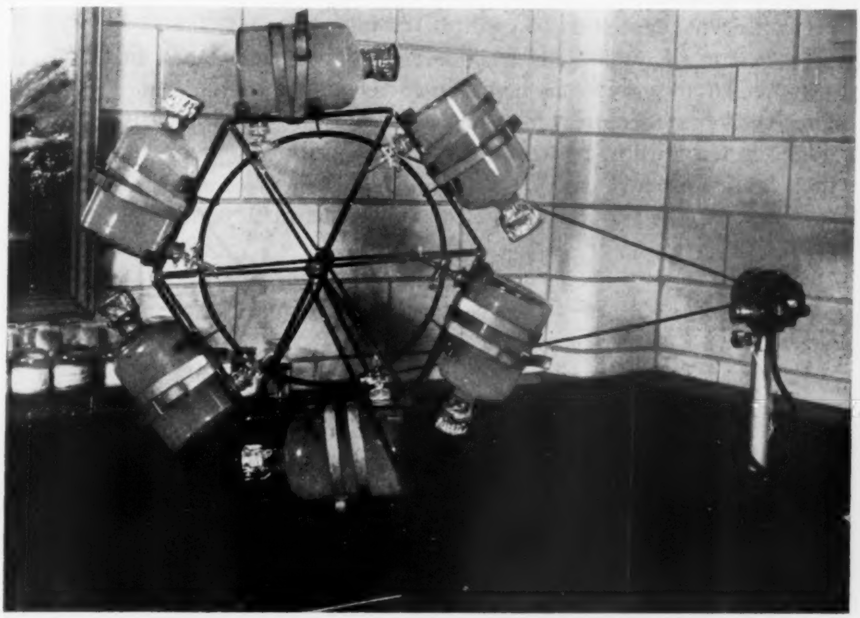

FIG. 2. Wheel for Agitation of Bottle Treatments

in the varying dilutions of tap water. These involve chlorine residuals, ammoniation, etc., and it is easy to surmise that variable dilutions of such water with de-chlorinated (carbon-filtered) water, containing variable residual ammonia, may be subject to chemical changes affecting odor values when allowed to stand during the test. The same dilutions made immediately before observation might have shown either more or less odor.

There is some indication that dilutions, upon standing, usually have greater than aliquot odor. Segregation of the data for observers C–F, Table 1, into groups according to dilution is made in Table 4. The trend to high deviations among diluted samples is unmistakable. On the other hand the difference between chlorinated and unchlorinated dilutions is not so marked.

A further bit of evidence pointing to erratic results from dilutions prepared in advance is shown in Table 5, which lists all available tests in which more than one observer measured the same set of known dilutions. The interesting fact brought out by this table is the excellent agreement between observers, notwithstanding the fact that the odors of the previously diluted samples are not in proportion to the dilution. Usually the diluted sample has more odor, proportionately, than the undiluted sample. On several occasions when such inconsistent results were obtained, i.e., when a previously diluted stock showed more than its aliquot odor, direct observation seemed to confirm the measurement.

The matter of anomalous responses should be mentioned in this connection. An observer may sometimes recognize an odor at a dilution higher than one or more which he has already declared negative, or conversely he may fail to recognize an odor at a dilution below one or more which he has already called positive. Such responses are called anomalous; they may be simple errors of observations or they may be caused by

TABLE 4

Effect of Prior Dilution on Accuracy

DEVIATION	ALL TESTS	DILUTIONS	NO DILUTIONS	CHLORINATED DILUTIONS	UNCHLORINATED DILUTIONS
Average, %	9.3	11.7	6.2	12.5	10.3
Standard, %	13.7	14.9	10.7	16.2	12.9

changes in the level of response of the observer. This phenomenon has immense interest from a psycho-physical standpoint but sometimes receives more attention than is warranted in this purely practical problem. The threshold might be defined as either the beginning or end of a doubtful or twilight zone, or it might be the middle point at which an equal number of positive and negative responses would be obtained. Such a point or zone must always exist theoretically. Even when the sharpest cleavage is obtained between positives and negatives in adjacent dilutions it must be assumed that between the last negative and the first positive is a zone where differentiation breaks down. This is a subject dealt with incidentally by Pavlov in his lifetime study of conditioned reflexes. The persistence of that investigator is to be commended to the troubled student. In this connection, however, interest is confined to practical implications.

Anomalous responses are objectionable because they prolong the test unnecessarily. The time required for a test is proportional to the number of dilutions which must be submitted for a reasonably clear decision.

If in the time available either one long or three or more repeated tests can be completed, the latter have tremendous advantage over the former in quality as well as quantity of work. Three tests agreeing closely would establish a reliable average, whereas one test leaves the issue in doubt. Hence, the observer who is making anomalous responses should be given a rest. If his failing is habitual he is seriously handicapped for odor work.

TABLE 5

Comparative Observations of Two Observers on the Same Set of Known Dilutions

DATE	PERCENTAGE DILUTION	OBSERVERS		CORRECTED FOR DILUTION	PERCENTAGE DEVIATION	
		D	C		Between Samples	Between Observers
			Tap Water Samples			
1-31-41	50	3.98	3.72	7.70	+32.8	±3.4
	85	5.31	5.44	6.33	+9.1	±1.2
	100	3.32	3.44	3.38	−41.7	±1.8
			Raw Water Samples			
12-10-40	50	11.5	8.0	19.5	+4.6	±17.9
	100	16.0	19.5	17.8	−4.6	±9.9
		F	E			
1- 7-41	30	2.94	2.95	9.82	+6.4	±0
	60	4.95	5.22	8.47	−8.2	±2.7
	100	9.55	9.27	9.41	+1.8	±1.5
3-10-41	50	3.37	3.11	6.48	+56.0	±4.0
	100	1.68	1.98	1.80	−56.0	±8.2
3-11-41	50	1.70	1.61	3.31	+13	±3.2
	100	2.50	2.59	2.55	−13	±1.8
Average					±18.9	4.6

A single example, the only one available, of a wide zone of uncertainty carried to its ultimate conclusion is submitted in work sheets of duplicate tests by E and F (Fig. 3). F, who is usually consistent, in this case suffers what may be called a temporary neurosis, which probably could have have been dispelled by a rest and a fresh start. Instead, he was forced to a decision by having to pass on 83 dilutions of the three samples in addition to numerous blanks. The low dilution end of the zone was confirmed by five to six adjacent positives for each sample. The high dilution end was

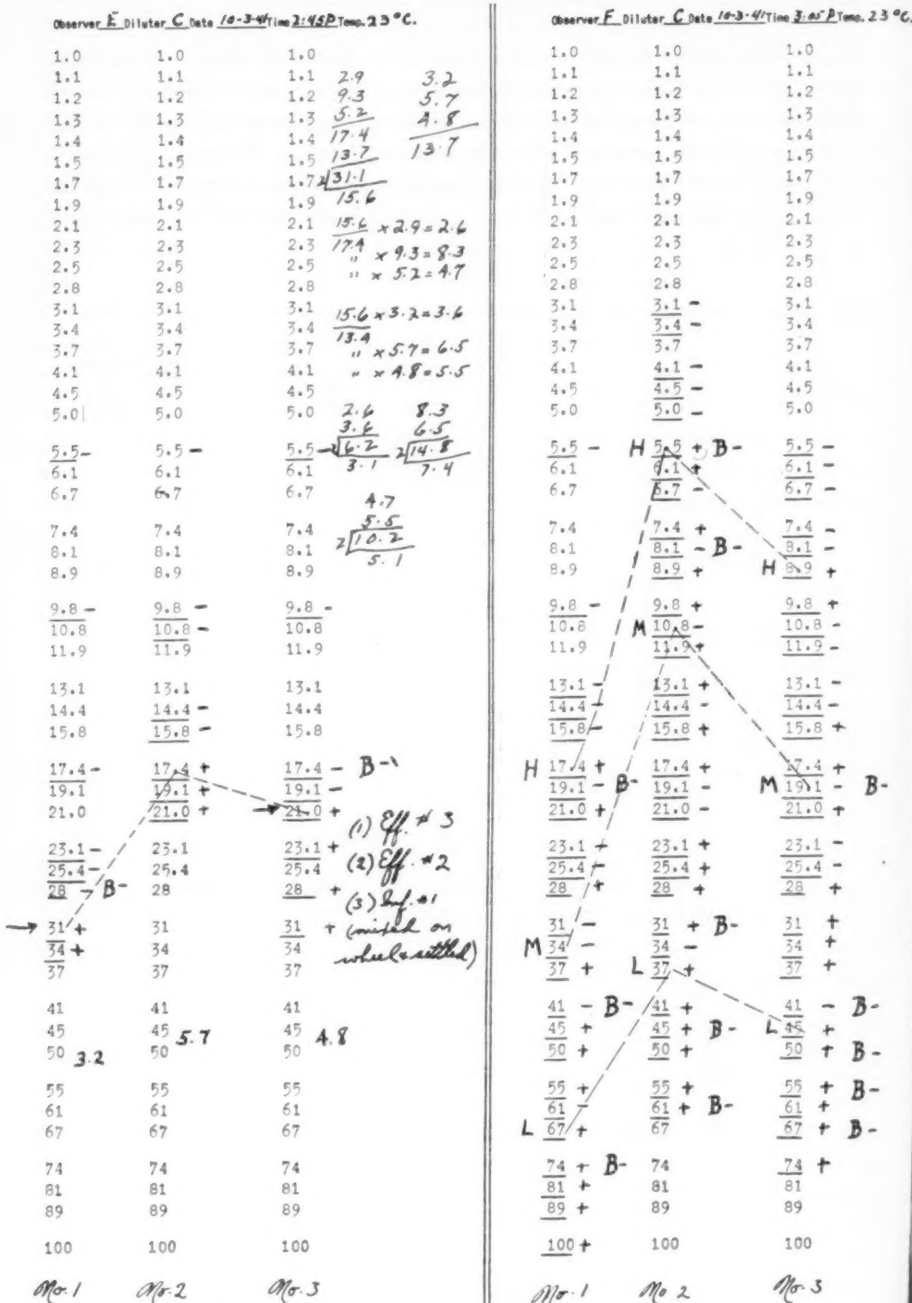

FIG. 3. Specimen Work Sheets of Observers E and F

confirmed by three to five adjacent negatives. The drift was toward the low dilutions so that that end required most confirmation. There were 22 anomalous responses in the three samples which were alternated and completed in parallel. Upon completion of the test and recession of positives to fill anomalous negatives, F's results were compared with those of E who experienced no difficulty and made no anomalous responses. The comparison of results on the three samples was as follows:

	1	*2*	*3*	*No. Trials*	*Minutes*
E found	3.6	6.5	5.5	24	15
F found	2.6	8.3	4.7	83	80
Average	3.1	7.4	5.1		

E's record in this instance is perfect. F's record is bad, though not at all typical. Considered jointly and with the background of other results it is rather clear that anomalous responses are a problem of the individual. The fault may be temporary as in this case or it may be chronic as shown by qualifying or other tests. F's work sheet is an example of "strong arm" evaluation.

The form of record used provides the scale of dilutions for each sample. As soon as a dilution is prepared, the quantity is underscored. When the response is made the record is completed by a plus or minus sign. When a blank is interposed, the letter "B" is entered following the test which preceded it. An unusual number of blanks was used in the case cited but all responses were correct on these. The items marked "H" were the first positives. The items marked "L" were the lowest negatives. The items marked "M" are those from which T.O. would usually be calculated.

Obviously the method applied to F is not to be recommended for routine procedure. Curiously enough, if the first impressions which F failed to verify had been accepted without confirmation the relative values of the odors of the three samples would have been almost the same. The averages of weighted values by E and F for the three samples would then have been 2.85, 7.4 and 5.3 instead of 3.1, 7.4 and 5.1.

Weighted Values

The term "weighted values" requires explanation. The values in Table 5 are weighted values, as are all subsequent T.O. values reported. The process of weighting and the reason for it can best be explained by examples:

Four observers—C, D, E and F—made six parallel measurements of two samples of water (influent and effluent of a basin), E and F making

two measurements and C and D, one each. Primary results are shown in Table 6.

The variation of 400 per cent from low to high results should be noted. Such results are not uncommon. At first glance they appear to preclude evaluation of activated carbons or any other methods or materials for odor removal. Actually the results are far more consistent and useful than would first appear to be true.

Reference is made to two propositions already discussed: first that measurement of odor as required and here employed is a comparison of relative values; and second that accuracy or precision is agreement with the average under like conditions. Assuming that an individual's observations vary by ± 20 per cent from the average, if his first answer is 8, he may measure the odor of another sample of the same water and obtain 12 on the second test. If the identity of the second sample is unknown he might conclude that the second sample contains 50 per cent more odor

TABLE 6

Comparative Sensitivity Levels of Observers

OBSERVER	TIME P.M.	THRESHOLD ODORS	
		Influent	Effluent
D	2:10	10.2	5.7
F	3:15	22.2	11.2
F	3:45	29.4	12.3
E	3:55	14.9	11.2
C	4:10	43.5	20.0
E	4:35	20.0	10.2

than the first. The confusion resulting is obvious. This situation was implied by Eq. 1. On the other hand, assuming that the individual has made many measurements, dividing them into three groups of equal number labeled high, low and median, by placing all the results in a hat and drawing a single test, it is evident that he has only one chance in three of drawing the median or correct answer. Two chances out of three the result will be high or low. If he is allowed to draw twice, replacing the ballot after the first time, however, the chances of the average of two drafts being high or low are very different. There are *nine* possible combinations of events in this case, only two of which will yield as wide a deviation as would have occurred in two-thirds of the single drawings. All other combinations will be average or near average. If drawings are considered in groups of three the probable deviation is still lower, i.e., for the maximum deviation only two chances in 27. This fact is stated mathematically as follows:

The average error A, affecting the averaged value of all n observations, is given by the expression:

$$A = \pm \frac{\Sigma d}{n\sqrt{n}} \qquad (2)$$

where $\Sigma\, d$ is the sum of all the deviations from the average and n is the number of measurements.

The probable error, r, of a single one of n measurements is:

$$r = \pm 0.6745 \sqrt{\frac{\Sigma d^2}{n - 1}} \qquad (3)$$

and the probable error, R, of the average of n measurements is (Bessel's formula):

$$R = \pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n - 1)}} \qquad (4)$$

An examination of Table 6 will indicate that the levels of sensitivity of the several observers are widely different and that the level of the same observer also changes between tests. This is a common experience. It introduces another problem, that of a method of averaging values of different magnitude so as to give the same weight to each value. For example, two observers obtain the following results:

Observer	*Water No. 1*	*Water No. 2*
A	10	20
B	1	2
Average	5.5	11

Both have obtained the same results at different levels of perception or response. The average shows the same result as either, i.e. that water No. 2 contained twice as much odor as water No. 1. If, on the other hand, the following had resulted:

Observer	*Water No. 1*	*Water No. 2*
A	10	20
B	2	1
Average	6	10.5

B's opinion would have been overshadowed by the numerical size of A's results, and the averages are misleading or meaningless.

Furthermore the results of one observer can be raised or lowered to the level of the other without disturbing the relation between the two samples. Thus, since the total of A's measurements is 10 times that of B, B's measurements can be multiplied by 10 or A's divided by 10, to obtain figures which can be averaged.

The author is indebted to John Hassler for pointing out the analogy of two analysts reporting the comparative weights of two masses but using different units. If A used decigrams while B used grams it would be necessary to go through the same process as suggested above. In the case of odor measurements the size of the unit which either observer uses is not known, but the relative size is indicated by the total for the several samples being compared.

Instead of making the adjustment or weighting in favor of one individual, it is preferable (though not imperative) to bring both to a median value as follows:

The sum of A's values is	30
The sum of B's values is	3
Total	33
Average	16.5

A's results may be reduced to this level by multiplying by the factor $\frac{16.5}{30} = 0.55$. B's results may be raised to this level by multiplying by the factor $\frac{15.6}{3} = 5.5$. The comparison of results then shows:

Observer	*Water No. 1*	*Water No. 2*
A	5.5	11.0
B	11.0	5.5
Average	8.25	8.25

The results having been equally weighted it appears, as was evident before, that the two observers' opinions are in disagreement equally and neutralize each other. Both results are unsatisfactory from the standpoint of accuracy, but if they are to be accepted without additional tests we must conclude that the odors of the two samples are of equal magnitude. The weighting factor, which is the ratio of the average of all T.O. values to the individual average, may be designated by the letter *W*.

Table 6 may then be revised as shown in Table 7. It may be of interest to point out that the ratio of A to B which is obtained by the averaging of weighted values is identical with the logarithmic mean of the individual ratios which may be computed equally well from the original unweighted values, thus:

$$\text{Weighted } \frac{A}{B} = \frac{23.0}{12.1} = 1.9 = \sqrt[6]{\frac{A_1}{B_1} \times \frac{A_2}{B_2} \times \frac{A_3}{B_3} \times \frac{A_4}{B_4} \times \frac{A_5}{B_5} \times \frac{A_6}{B_6}}$$

The averaging of weighted values facilitates study of deviations and is

therefore preferred. From Eq. 4, the probable error R of the average of Column A is 2.0 per cent and of Column B is 3.6 per cent.

Plant Samples

The next group of data to be considered consists of miscellaneous plant samples which have been compared from March 14 to June 4, 1941, and on which duplicate determinations were made either by the same or another observer. Numerous check determinations had been made prior to this time but the form of work sheet and other details of technic make this a convenient starting point. All plant tests made during the period except two which were incomplete are included. All results have been weighted by the sensitivity factor W. It should be of interest to know that the great majority of these tests were made before the mathematical

TABLE 7

Comparison of Two Waters by Weighted Values

TEST NO.	OBSERVER	THRESHOLD ODORS		TOTALS, A + B	WEIGHT	WEIGHTED THRESHOLD ODORS	
		A	B			A	B
1	D	10.2	5.7	15.9	2.21	22.6	12.6
2	F	22.2	11.2	33.4	1.05	23.3	11.8
3	F	29.4	12.3	41.7	0.84	24.7	10.4
4	E	14.9	11.2	26.1	1.34	19.9	15.0
5	C	43.5	20.0	63.5	0.55	24.0	11.1
6	E	20.0	10.2	30.2	1.16	23.2	11.8
Averages..............................				35.1		23.0	12.1

interpretation was devised—about May 25, 1941. Therefore, not only were the tests blindfold but their ultimate significance was unknown to anyone because the interpretation came weeks or months later, when the sensitivity factor was applied.

It is to be remembered that errors in these measurements are derived from many sources in addition to the response of the individual. Many of these errors can never be detected once they are made. They include errors of measuring water, identification of samples and dilutions, records and arithmetic. It would be strange indeed if such errors did not occur. Nevertheless, all duplicate plant data have been included in Table 11 and no changes other than final weighting calculations have been made.

In the 195 measurements comprising this group there were 110 anomalous positives, an average of about five for each nine samples of water. The average error of the table is 12.6 per cent. The individual averages

are: C, 16.5; D, 11.7; E, 11.4; F, 10.0; and G, 11.3. Evidently C is as bad as, or worse than, in the qualifying tests and it is frequently obvious that a poor result averaged with a consistent group introduces an apparent error in the group as a whole. This fact may well account for small increases in the average errors of the other observers.

It sometimes happens that an erratic item stands out prominently. For example, in the group of 12 tests on May 7, the item 3.31 is clearly low, thereby throwing the whole group out of balance. If either the column or the line containing this item is omitted, the remainder of the group is then in excellent agreement. If the column is omitted all measurements of sample 2 on this date are rejected. If the line is omitted all measurements by C_1 (first trial by C) are rejected. In the first alternative the average error will be reduced from 12.6 to 3.4 per cent and the maximum error from 37.2 to 5.9 per cent. If the second alternative is followed, the average error will be reduced to 0.8 per cent and the maximum to 4.1 per cent.

Other interesting cases will be found, for example, on the following day C_1 is again responsible for the greatest deviation. This group (May 8) as it stands shows an average error of 21.5 per cent and maximum 45.2 per cent, while if C_1 is rejected the average error is 2.5 per cent and the maximum 5.1 per cent. Again on May 15, C has reversed himself on two tests, C_1 and C_2, so that the average T.O. values are almost identical with two tests made by D on the same samples, which are in perfect agreement with each other.

It will be remembered that these computations were made long after the tests. They are not an exhibit of maximum accuracy but a study of routine tests previously made. The question naturally arises as to how they could have been improved. It appears logical to establish a limiting probable error, R, for the average T.O. of any sample. R may be computed from Bessel's formula, Eq. 4. Values of R are shown in parentheses in Table 8. If a limit of $R = 10$ were placed on this table, ten of the 27 group comparisons would be rejected. Failure to meet this requirement would necessitate additional measurements until the results were satisfactory. Failure of part of the group to meet the criterion, however, does not eliminate all other samples in the same group. Relative values of 1 and 2 may be accepted regardless of difficulties with 3 or 4.

Of obvious help to accuracy would have been the elimination of C as an observer, his results having been less satisfactory in the qualifying tests. Apparently an observer with an average error record below 12 per cent should be sought. Half of those tested can meet this standard. Distribution of errors is shown in Table 9.

TABLE 8

Weighted Threshold Odors of Miscellaneous Plant Samples

DATE	OBSERVER	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4	
		T.O.	% Dev.	T.O.	% Dev.	T.O.	% Dev.	T.O.	% Dev.
3-14-41	F_1	4.18	−12.5	10.92	−1.9	26.16	+3.3		
	F_2	5.37	+12.5	11.35	+1.9	24.50	−3.3		
	Avg.	4.78	(8.4)	11.14	(1.3)	25.33	(2.2)		
3-17-41	E	7.23	−20.7	5.82	+38.2	15.25	+1.5		
	F	10.92	+20.7	2.60	−38.2	14.79	−1.5		
	Avg.	9.08	(14.0)	4.21	(25.6)	15.02	(1.0)		
3-18-41	C	21.2	+5.5	4.14	+6.2	14.5	−8.5		
	F	19.0	−5.5	3.66	−6.2	17.2	+8.5		
	Avg.	20.1	(3.7)	3.90	(4.4)	15.9	(5.7)		
3-26-41	D	6.54	−9.8	7.95	+18.7	2.26	−19.4		
	G	7.96	+9.8	5.44	−18.7	3.35	+19.4		
	Avg.	7.25	(6.6)	6.70	(12.3)	2.81	(13.1)		
4-15-41	F	3.70	−10.0	3.42	−3.7	5.98	+6.0		
	G	4.53	+10.0	3.69	+3.7	4.87	−6.0		
	Avg.	4.12	(6.7)	3.56	(2.5)	5.18	(4.1)		
4-22-41	C	4.00	−14.6	7.76	−0.6	6.33	+13.0		
	D	5.37	+14.6	7.86	+0.6	4.87	−13.0		
	Avg.	4.69	(9.8)	7.81	(0.4)	5.60	(8.8)		
4-24-41	E	4.07	+8.5	3.02	−12.7	3.22	−7.7		
	F	3.30	−12.0	3.68	+6.4	3.30	−5.4		
	D	3.06	−18.4	3.68	+6.4	5.05	+44.7		
	C	4.58	+22.2	3.44	−0.6	2.38	−31.8		
	Avg.	3.75	(6.3)	3.46	(3.0)	3.49	(10.8)		
4-25-41	F	7.28	−9.4	4.49	−0.4	7.28	+12.3		
	D	7.98	−0.6	3.99	−11.5	7.10	+9.6		
	C	8.83	+10.0	5.06	+12.2	5.06	−21.9		
	Avg.	8.03	(3.8)	4.51	(4.6)	6.48	(7.4)		
4-28-41	D	2.48	+13.0	2.89	−4.6	2.27	−6.2		
	C	(1.91)	−13.0	3.17	+4.6	2.57	+6.2		
	Avg.	2.195	(8.8)	3.03	(3.1)	2.42	(4.2)		
4-30-41	F	2.42	−17.4	4.67	+37.8	8.35	−8.5		
	D	2.21	−24.6	2.37	−30.0	10.90	+19.4		
	C	4.16	+42.0	3.12	−8.0	8.15	−10.8		
	Avg.	2.93	(14.3)	3.39	(13.5)	9.13	(6.6)		

TABLE 8—*Continued*

DATE	OBSERVER	SAMPLE 1 T.O.	SAMPLE 1 % Dev.	SAMPLE 2 T.O.	SAMPLE 2 % Dev.	SAMPLE 3 T.O.	SAMPLE 3 % Dev.	SAMPLE 4 T.O.	SAMPLE 4 % Dev.
5- 1-41	D	2.36	+6.8	1.50	−33.0	2.89	+26.3		
	C	2.06	−6.8	3.00	+33.0	1.69	−26.3		
	Avg.	2.21	(4.6)	2.25	(22.3)	2.29	(17.7)		
5- 5-41	E	1.47	+14.0	1.60	−1.8	1.47	−9.3		
	D	1.19	−7.8	1.62	−0.6	1.73	+6.8		
	C	1.21	−6.2	1.66	+1.8	1.66	+2.4		
	Avg.	1.29	(4.7)	1.63	(0.7)	1.62	(3.2)		
5- 6-41	E	8.25	+13.5	2.91	−20.9	3.88	−4.7		
	D	6.78	−6.7	3.79	+3.0	4.70	+15.5		
	C	8.86	+21.9	2.81	−23.6	3.46	−15.0		
	F	5.20	−28.5	5.20	+41.3	4.24	+4.2		
	Avg.	7.27	(7.6)	3.68	(10.1)	4.07	(4.4)		
5- 7-41	C_2	2.69	−10.9	6.38	+21.1	3.61	−3.2	7.05	−8.2
	C_1	3.58	+18.6	3.31	−37.2	4.35	+16.6	8.48	+10.4
	D	2.78	−8.0	6.11	+15.9	3.23	−13.4	7.50	−2.3
	Avg.	3.02	(6.3)	5.27	(12.6)	3.73	(5.9)	7.68	(3.7)
5- 8-41	C_1	4.68	+41.0	5.70	+38.4	3.53	−45.2	3.55	+1.7
	D	2.58	−22.3	3.13	−24.0	8.05	+25.0	3.53	+1.7
	C_2	2.69	−19.0	3.52	−14.5	7.79	+21.6	3.34	−3.7
	Avg.	3.32	(13.9)	4.12	(13.1)	6.44	(15.5)	3.47	(1.2)
5- 9-41	D	1.92	+7.9	2.15	−5.9				
	C	1.65	−7.9	2.42	+5.9				
	Avg.	1.78	(5.3)	2.28	(4.0)				
5-13-41	C_2	6.47	0.0	5.37	0.0				
	C_1	5.92	−8.5	5.92	+10.2				
	E_2	7.28	+12.5	4.55	−15.3				
	E_1	6.20	−4.18	5.62	+4.7				
	Avg.	6.47		5.37					
5-14-41	C	2.71	−16.4	2.46	+27.5				
	D	3.27	+0.9	1.91	−1.0				
	F	3.73	+15.1	1.43	−25.9				
	Avg.	3.24		1.93	(10.4)				
5-15-41	D_2	2.83	−0.4	2.12	+0.5				
	C_2	2.12	−25.3	2.83	+34.1				
	D_1	2.83	−0.4	2.12	+0.5				
	C_1	3.57	+25.7	1.38	−34.6				
	Avg.	2.84		2.11	(9.5)				

TABLE 8—*Concluded*

DATE	OBSERVER	SAMPLE 1		SAMPLE 2		SAMPLE 3		SAMPLE 4	
		T.O.	% Dev.	T.O.	% Dev.	T.O.	% Dev.	T.O.	% Dev.
5-16-41	C_1	3.52	−13.5	3.81	+16.9				
	C_2	5.02	+23.3	2.31	−29.1				
	E	3.66	−10.1	3.66	+12.3				
	Avg.	4.07		3.26	(9.9)				
5-17-41	C	6.57	−24.2	5.45	+62.7				
	D_1	10.2	+18.0	1.79	−46.6				
	D_2	9.2	+6.2	2.82	−15.8				
	Avg.	8.66		3.35	(21.9)				
5-20-41	D	22.6	−1.7	12.6	+4.1				
	F_1	23.3	+1.3	11.8	−2.5				
	F_2	24.7	+7.1	10.4	−14.0				
	E_1	19.9	−13.5	15.0	+24.0				
	C	24.0	+4.3	11.1	−8.3				
	E_2	23.2	+0.8	11.8	−2.5				
	Avg.	23.0		12.1					
5-22-41	C	45.5	+1.8	4.65	−13.1				
	D	44.8	+0.2	5.41	−1.2				
	F	43.8	−2.0	6.41	+14.2				
	Avg.	44.7		5.49					
5-30-41	F_2	3.64	+3.7	3.91	−2.7				
	F_1	3.42	−3.7	4.13	+2.7				
	Avg.	3.53		4.02					
5-31-41	D	15.80	−8.7	8.93	+20.0				
	F	18.80	+8.7	5.95	−20.0				
	Avg.	17.30		7.44	(13.5)				
6- 3-41	F_1	1.28	+2.0	6.63	−0.3				
	F_2	1.23	−2.0	6.67	+0.3				
	Avg.	1.255		6.65					
6- 4-41	F	10.1	+6.9	1.20	−34.8				
	E	9.13	−3.4	2.16	+17.4				
	D	9.13	−3.4	2.16	+17.4				
	Avg.	9.45		1.84	(11.8)				

Activated Carbon Tests

Another group of data to be considered includes tests of activated carbons. These tests introduce still more complications and pitfalls. Trial treatments in bottles offer many possibilities of error and it would not be surprising if these results should show wider deviations than Tables 1 or 8 which are mostly clear samples or not subject to rapid clarification. The technic (see Appendix, p. 906) is believed to be more reliable than previously published procedure. In general, the correctness of any procedure can be demonstrated by the degree of consistency attained. In the data here, differences in degree of clarification of the sample may afford partial explanation of deviations. As in previously discussed measurements, errors or deviations are overall accumulations of every sort, not merely the sensitivity of the observer. Hence final accuracy may be more difficult to attain.

TABLE 9

Deviations of Plant Tests

	MINUS							−3.4 3.4	PLUS							
	45.5 52.4	38.5 45.4	31.5 38.4	24.5 31.4	17.5 24.4	10.5 17.4	3.5 10.4		3.5 10.4	10.5 17.4	17.5 24.4	24.5 31.4	31.5 38.4	38.5 45.5	45.5 52.4	Above 52.5
No. of Deviations...........	1	1	6	7	12	20	31	45	29	18	13	4	5	4	0	1
Percentage Deviation............	0.5	0.5	3.1	3.6	6.1	10.1	15.7	22.8	14.7	9.1	6.6	2.1	2.5	2.1	0.0	0.5

Comparisons have been made between an activated carbon, S, and seven other carbons, lettered A to G. The results are given in Table 10. The first line shows the residual odor of water treated with the standard carbon, S, expressed as a percentage of the residual odor of the same water treated with each of the other carbons. For example, if treatment with carbon A leaves T.O. 10.0, carbon S leaves T.O. 6.3. The second line shows the number of completed comparisons. The third and fourth lines show the probable errors, *R*, of the averages used in the comparisons.

It is of casual interest that carbon G was later found to be the same carbon (not the same sample) as Carbon S. The result in this case is an overall check of the method. Also E^1 is the same as E, but represents results obtained three months later, which results were overlooked in the first tabulation.

The original and weighted T.O. values used in all of the computations are shown in Table 11. Weighting and calculation of errors are mostly by slide rule. It will be found that the relative values of these carbons have not been greatly affected by differences in dosage on different sample of water in most instances. In a few instances there have been changes in the relations. For example, A would have a value of 75 on the basis of the data on February 8, while the value obtained on February 20 and 21 was 44. Two other tests of A on February 26 and March 4 and 5 showed 58 and 66 while the composite average of all tests is 63. Such differences would require verification before attaching too much significance to them. They may be due to changes in the character of odor substance. In Table 12 the deviations have again been tabulated in probability form for comparison with previous experience.

TABLE 10

Rating of Activated Carbons (100S/×)

CARBON ×	A	B	C	D	E	F	G	E^1
Ratio 100S/× (Residual Odors)	63	49	47	64	86	42	97	88
No. of Tests	17	5	7	12	10	4	3	3
Probable Error of S, %	3.5	3.7	6.2	3.8	1.9	2.4	6.2	2.3
Probable Error of ×, %	2.3	1.7	0.9	2.4	1.7	1.1	6.0	2.0

Conclusions

1. Relative values of activated carbons have been measured by threshold odor.

2. The necessity of testing the observer and technic is shown and a method described. Qualification should be on the basis of agreement of duplicate samples.

3. Weighted values permit averaging the results of tests made at different reflex levels.

4. The method of weighted averages frequently reveals the source of disagreement whether it is a particular sample or an individual.

5. The data reveal no inherent disagreement between observers. Deviations between tests of a single observer are as great and frequent as between observers of equal accuracy.

6. Deviations from average values show typical probability curves of frequency. This applies equally to individuals or groups.

7. Evidence that dilutions prepared in advance develop odors out of proportion to the dilution is shown. This points to immediate testing of

TABLE 11

Original and Weighted Threshold Odor Values of Various Carbons

DATE	OBSERVER	CARBON	THRESHOLD ODORS: As Found: Test Carbon	THRESHOLD ODORS: As Found: Carbon S	THRESHOLD ODORS: Weighted: Test Carbon	THRESHOLD ODORS: Weighted: Deviation	THRESHOLD ODORS: Weighted: Carbon S	THRESHOLD ODORS: Weighted: Deviation
		ppm.				%		%
Carbon A								
2- 8-41	E	—	2.7	2.7	9.32	−18.6	9.32	+29.7
2- 8-41	F	—	27.0	15.0	12.0	+4.9	6.65	−6.1
2- 8-41	E	—	3.6	2.9	10.31	−10.0	8.30	+15.5
2- 8-41	F	—	29.0	22.0	10.59	−7.4	8.03	+12.0
2- 8-41	E	—	2.7	1.6	11.69	+2.2	6.93	−3.6
2- 8-41	E	—	3.2	2.9	9.77	−14.6	8.85	+22.9
2-21-41	D	8	6.9	4.3	11.47	+0.3	7.15	−0.6
2-21-41	C	8	16.4	5.7	13.80	+20.6	4.80	−33.3
2-20-41	F	8	5.7	3.2	11.92	+4.3	6.69	−7.0
2-20-41	E	8	5.7	1.6	14.59	+27.0	4.08	−43.3
2-26-41	E	8	3.2	1.2	13.54	+18.4	5.08	−29.4
2-26-41	F	8	3.9	3.9	9.32	−18.6	9.32	+29.7
3- 4-41	C	20	8.4	5.7	11.10	−3.0	7.53	+4.7
3- 4-41	F	20	29.4	13.5	12.77	+11.6	5.86	−18.5
3- 4-41	E	20	5.7	5.7	9.32	−18.6	9.32	+29.7
3- 5-41	D	20	20.0	14.9	10.67	−6.7	7.95	+10.9
3- 5-41	F	20	24.0	12.3	12.31	+7.6	6.31	−12.6
Average					11.44		7.19	
Probable Error, R						2.3		3.5
Carbon B								
11- 6-40	C	5	3.5	1.6	13.7	+2.8	6.25	−4.6
11-11-40	C	5	7.0	2.5	14.7	+9.9	5.23	−19.9
11-12-40	C	5	7.0	3.8	12.9	−3.6	7.00	+6.7
8-27-41	C	7.7	29.4	16.4	12.8	−4.3	7.12	+8.5
8-27-41	H	7.7	18.2	10.2	12.8	−4.3	7.17	+9.3
Average					13.38		6.55	
Probable Error, R						1.7		3.7
Carbon C								
2-20-41	F	8	6.3	3.2	109.8	−2.5	55.7	+9.1
2-20-41	E	8	6.3	1.6	132.0	+17.2	33.5	−37.0
2-28-41	C	8	222	110	110.5	−1.9	54.8	+3.6
2-27-41	E	8	123	36	128.0	+13.7	37.4	−29.4

TABLE 11—*Continued*

DATE	OBSERVER	CARBON	THRESHOLD ODORS					
			As Found		Weighted			
			Test Carbon	Carbon S	Test Carbon	Deviation	Carbon S	Deviation
		ppm.				%		%
Carbon C								
2-27-41	D	8	182	112	103.2	−8.4	63.0	+19.1
2-27-41	F	8	200	135	98.8	−12.3	66.7	+26.1
3- 6-41	F	20	12.3	6.9	105.8	−6	59.3	+12.1
Average					112.6		52.9	
Probable Error, *R*						0.9		6.2
Carbon D								
2-21-41	D	8	6.9	4.3	61.6	+0.9	38.4	−1.4
2-21-41	C	8	10.2	5.7	64.2	+5.4	35.8	−8.1
2-28-41	C	16	149	110	57.5	−5.8	42.4	+8.7
2-27-41	E	16	149	36	80.6	+32.0	19.5	−50.0
2-27-41	D	16	164	112	59.4	−2.7	40.6	+4.2
2-27-41	F	16	182	135	57.4	−5.9	42.6	+9.4
3- 4-41	C	20	10.2	5.7	64.2	+5.4	35.8	−7.9
3- 4-41	F	20	18.2	13.5	57.4	−5.9	42.6	+9.4
3- 4-41	E	20	5.7	5.7	50.0	−16.4	50.0	+28.3
3- 5-41	D	20	18.2	14.9	54.9	−10.2	45.0	+15.5
3- 5-41	F	20	24.0	12.3	66.1	+8.3	33.9	−12.9
3-21-41	D	20	3.9	2.7	59.1	−3.2	40.9	+5.0
Average					61.03		38.96	
Probable Error, *R*						2.39		3.78
Carbon E								
1-11-41	F	5	3.2	2.7	7.2	+1.6	6.0	−1.7
1-11-41	E	5	5.7	5.2	6.9	−2.7	6.3	+3.3
2- 8-41	E	—	2.7	2.7	6.6	−6.9	6.6	+8.3
2- 8-41	F	—	24.0	15.0	8.1	+14.1	5.1	−16.7
2- 8-41	E	—	3.6	2.9	7.3	+3.0	5.9	−3.3
2- 8-41	F	—	22	22.0	6.6	−6.9	6.6	+8.3
2- 8-41	E	—	2.4	1.6	7.9	+11.4	5.3	−13.1
2- 8-41	E	—	2.9	2.9	6.6	−6.9	6.6	+8.3
2-26-41	E	8	1.4	1.2	7.1	+0.1	6.1	±0.0
2-26-41	F	8	3.9	3.9	6.6	−6.9	6.6	+8.3
Average					7.09		6.11	
Probable Error, *R*						1.7		1.9

TABLE 11—*Concluded*

DATE	OBSERVER	CARBON	THRESHOLD ODORS					
			As Found		Weighted			
			Test Carbon	Carbon S	Test Carbon	Deviation	Carbon S	Deviation
		ppm.				%		%
Carbon F								
10–28–40	C	2.0	12.0	4.3	9.18	+4.6	3.29	−11.3
10–30–40	C	2.0	8.5	4.0	8.50	−3.1	4.00	+7.8
10–31–40	C	2.0	8.0	3.5	8.67	−1.1	3.79	+2.2
11– 4–40	C	5.0	7.0	3.0	8.73	−0.4	3.74	+0.8
Average					8.77		3.71	
Probable Error, *R*						1.08		2.4
Carbon G								
5–24–41	C	10	71	48	57.7	+17.6	39.0	−18.1
5–24–41	F	10	40	49	43.5	−11.4	53.3	+11.8
5–24–41	D	10	39	43	46.0	−6.2	50.7	+6.4
Average					49.07		47.67	
Probable Error, *R*						6.0		6.2
Carbon E[1]								
5–29–41	C	10	48	48	49.7	−5.69	49.7	+6.9
5–29–41	F	10	59	49	54.2	+2.8	45.0	−3.2
5–29–41	D	10	52	43	54.3	+3.0	44.9	−3.4
Average					52.7		46.5	
Probable Error, *R*						2.0		2.3

TABLE 12

Deviations of Carbon Tests

	MINUS							−3.4 3.4	PLUS				
	45.5 52.4	38.5 45.4	31.5 38.4	25.5 31.4	17.5 24.4	10.5 17.4	3.5 10.4		3.5 10.4	10.5 17.4	17.5 24.4	24.5 31.4	31.5 38.4
No. of Deviations	1	1	2	2	5	10	24	28	26	11	5	6	1
Percentage Deviation	0.8	0.8	1.6	1.6	4.1	8.2	19.7	23.0	21.3	9.0	4.1	5.0	0.8

dilutions as soon as prepared. In the adopted procedure the average contact time is about 30 sec. This is the time which elapses between preparation of the dilution and the observation.

Acknowledgements

This work was undertaken as a contribution to the A.W.W.A. Committee on Activated Carbon Research, Matthew M. Braidech, Chairman. The discussions of this committee stimulated inquiry and directed emphasis to the matter of discordant results and anomalous responses. The term "parallel determination" as employed here came from other members of the committee. Incidentally, it may be pointed out that the original measurements reported by the author were parallel determinations, broadly speaking, but the technic was not as rigorous, and emphasis on this point was lacking. The first data were also averages of numerous tests, but not weighted.

It was hoped, originally, to improve the odor technic by co-operative efforts of the committee. This attempt was fruitless, however, due, as it now appears, to inadequate interpretation of results which would reveal actual agreement or lack of agreement. In view of the data submitted it is felt that each operator must be the judge of his own technic since it avails but little to standardize all details except the most important one of the individual. It would be reasonable, however, to require that an analyst reporting an odor comparison state the number of tests comprising the report and the probable error of the averages. Certain other stipulations, such as temperature, are also essential. For the record it may be stated that the results reported herein were done at 24°C.

Acknowledgment is made to the personnel of the Springfield water purification plant, including M. D. Bray, N. P. Gale, C. W. Hartman, W. F. Madden, R. C. Pearce, F. H. Wilcoxon, Geo. S. Bonn and Dr. D. H. Caldwell for their co-operation and assistance in the tests as well as for their helpful suggestions.

Appendix—Test Procedures

For convenience of comparison of this method with that of the 1938 report of the Subcommittee on Specifications and Tests for Powdered Activated Carbons (Jour. A.W.W.A., **30:** 1133 (1938)), the description of test procedures here is arranged in the same order and with the same numbering system as that of the committee report.

A. Determination of Threshold Odor Values

1. *Apparatus*

1–1. One 5-ml. Mohr pipette, graduated to 0.1 ml., for each sample in the comparison. One 10-ml. graduated cylinder with 0.2-ml. subdivisions for each sample.

1–2. One 100-ml. graduated cylinder, with 1-ml. subdivisions, for each sample in the comparison.

1–3. Six 8-oz. flint glass bottles, with mushroom glass stoppers and $1\frac{1}{2}$-in. mouth. Bottles are preferable to flasks because they can be shaken with one hand without touching the mouth of the bottle with the hand. They also have a wider mouth than the flasks. The size of sample is 100 ml. and on this account two bottles can be shaken at one time, one in each hand, thus reducing time and energy required for many tests. Pyrex glass would be required for high temperatures, but the author uses 24°C.

1–4. No nose piece is used.

1–5. One chemical thermometer is sufficient.

1–6. Hot plates are not needed for 24°C. work.

1–7. Any sort of water bath may be used to bring temperature to 24°C. in stock samples and dilution water.

1–8. Laboratory carbon filter. A satisfactory carbon filter may be made from a train of granular carbon filled bottles. The bottles are interconnected by glass tubing, the inlet ending above the carbon and the outlet extending from the bottom of the bottle. The outlet of the last bottle in the train will have passed through a bed of carbon subsequent to contact with any rubber connections or stoppers. A train consisting of two 4-l. bottles is probably sufficient for most waters.

1–9. No distillation apparatus.

1–9.5. The unknowns to be tested are contained in 1-l. aspirator bottles having glass valved spouts near the bottom. These insure that all samples are receiving equal aeration and a minimum thereof. They permit rapid and convenient measuring of samples. They can be covered to conceal the identity of the sample.

2. *Reagents*

2–1. *Odor-free water.* Tap water filtered through the activated carbon has been used for blanks and dilutions. This practice is not above criticism. It is believed that distilled water filtered through carbon or boiled till 10 per cent or more is evaporated gives superior results, but this has not been definitely proved. The possibility of amine formation when chlorine is present in the water to be tested and ammonia in the dilution water suggests ammonia-free water for dilution.

A test of odor-free water is made by boiling a sample until 10 per cent has boiled away, cooling and comparing with the unboiled sample. This will reveal an odor if present in the unboiled sample.

3. *Procedure*

3–2. Approximate range is found or anticipated so that the first several dilutions of the test will be in the negative zone.

3–3. The volume of the diluted test portion is to be 100 ml. First, draw 40 ml. of odor-free water into a 100-ml. graduated cylinder from an 8-l. aspirator bottle used as a reservoir of odor-free water. Next add the measured test water, then fill to the 100-ml. mark with odor-free water. The measurement of quantities of test water below 3 ml. will be by graduated pipette. Above 3 ml., but less than 7 ml., will be measured with the small graduate. Above 7 ml. the measurement of test sample is made directly in the 100-ml. cylinder. Unless the amount of test sample required is more than 60 ml., the cylinder receives 40 ml. of odor-free water first, thus providing an immediate dilution of the test water. For the case of a water having an odor near 20, the first portion would preferably be 1.7 ml., added to 40 ml. of odor-free water in the cylinder, made up to 100 ml. with odor-free water, immediately transferred to the test bottle, submitted to the observer and the position of the bottle noted on the work sheet, where the dilution submitted is underscored in the column of dilutions corresponding to this sample.

3–4. The observer is previously provided with two similar bottles containing odor-free water. The use of two blanks may not be imperative but the tests reported here were made with two blanks, except those shown in Fig. 1, where only one blank was used. No bottle numbering is required in this routine and the bottles are in continuous circulation. One of the blanks is transferred to a freshly rinsed bottle, the empty blank bottle is used for the incoming sample. The outgoing sample bottle goes to a full rinse.

3–5. No flask or bottle warming is required, the samples and dilution water having been brought to temperature at which they will hold through-

out the test. This temperature is 23°–24°. The exact temperature is not important but it should be one which will hold without more than 0.5°C. variation.

3–6. Complete provision against prejudice is made by having the dilutor, as well as the observer, unaware of the identity of the samples. This avoids any tendency to assist by spoken word or mental telepathy. There being at least two samples under comparison, the order of the sample bottles can be arranged by the observer and the bottles covered with a towel or otherwise. The dilutions are then prepared, alternating from one sample to another.

3–7. The method of sniffing is not as important as uniformity in whatever method is employed. The success of the method depends on smooth working responses, the ability to say yes or no promptly following a routine of level attentiveness. This is a product of environment, health, disposition and technic. The bottles are shaken uniformly 15 times and the odor observed in prompt succession. The response is promptly given and recorded. The diluter has meanwhile prepared another dilution. The observer makes the changes in bottles, the fresh dilution is submitted. The whole cycle requires 30 to 60 sec.

3–8. Repeat procedures 3–3 and 3–7, increasing or decreasing the amount of odor-bearing water. Having started dilutions well above the probable threshold the following dilutions of the same water will be six intervals lower on the scale until a positive response is obtained. Following the first positive, the next dilution will be five intervals higher to confirm the previous negative, then back four dilution to confirm the previous positive. Thus, the positive and negative responses are brought closer until the record is complete. A record showing two consecutive positive dilutions below two consecutive negatives is acceptable if the observer is showing decision and consistency. If he is not, then three or more consecutive positives and/or negatives are needed to establish the positive and negative sides of the threshold. Within these two sides there may frequently be a reversal of responses, that is a negative at a lower dilution than a positive. These are to be expected. In computing the results such anomalous positives should be receded to replace the anomalous negatives.

4. *Recording Results*

4–1. The numerical value of the threshold odor is the reciprocal of the highest dilution found positive (after the recession of chance anomalous results). For example, if 5.0 ml. diluted to 100 ml. is distinguishable

while 4.5 ml. is not, the odor is $\frac{100}{5}$ or 20. For reliable results, the comparison must be repeated, preferably by a different observer. Weighted comparisons should check within a predetermined limit of probable error. The requirements of accuracy differ, depending on the purpose to be served. By repetition, the probable error of averages can be reduced below 5 per cent. This accuracy may not always be necessary.

4-2. The work sheets submitted (Fig. 1) should make further explanation unnecessary.

B. Bottle Tests of Carbons

1. *Apparatus*

Apparatus used in part A (1-1 through 1-9.5) is also used in these tests.

1-10. No filtering or vacuum treatment. The process of filtering, especially under vacuum, is a violent form of aeration. It is hard to believe that this would not introduce errors in many cases.

1-11. Open stirring jars are likewise aeration jars. The writer prefers to fill bottles of 1-l. capacity, leaving about 2 ml. of air bubble in each to act as an agitator. The bottles of treated water are revolved on a wheel mounted on a horizontal shaft. The bottles are the same glass-fitted aspirator bottles from which the water will later be drawn in the odor test.

2. *Reagents*

Reagents used in part A (2-1 and 2-2) are also employed here.

2-3. The use of paper pulp is eliminated with filtration.

2-4. Carbon stock suspension of 1 to 10 g./l. may be used.

3. *Procedure*

3-1. The dosage depends on the results desired. Results cannot be predicted and the dosage must be found by trial and error.

3-2. Plant treatment plus required carbon is added to the bottle of raw water.

3-3. Bottle treatments are made in rapid succession with hand agitation to disperse chemicals during the treatment.

3-4. All bottles are strapped to a wheel agitator and revolved for one hour or more as found desirable. If the time required for results equivalent to plant results is practical it should be used. This may not, however, be possible. The efficiency of precipitator units has been found impossible to match with bottle experiments when carbon dosage is equal.

3–5. After mixing, the samples are allowed to settle two hours. They are not filtered but are decanted in the odor test, using the spout and valve located near the bottom.

3–6. Comparative threshold odors are determined as prescribed under part A.

4. *Recording Results*

4–1. See part A (4–1 and 4–2).

4–2. The usefulness of double logarithmic plotting is in doubt, but may be investigated further.

1. Heating above 30°C. is not only unnecessary, but objectionable. It is granted that heating usually raises the odor value. It may make a 2 from a 1 or a 20 from a 10, but this has no more significance than changing quarts to pints or dimes to nickels. On the other hand, it sometimes actually reduces the odor value, e.g., a water with high residual chlorine and strong chlorinous odor had only slight earthy odor after heating to 60°C.

When heating raises the odor value it actually increases the percentage error of such factors as odor-free water. It has been noticed that observers who obtain lowest T.O. are most accurate.

3. The matter of cleansing apparatus can be overemphasized. The bottles used for these determinations have been used repeatedly with merely a full rinse. Hands must, however, be kept away from the necks of the bottles or flasks.

Water Quality Problems in Small Systems

By Lawrence H. Cook

WATER quality problems confront all water systems—large and small. The principal difference exists in the fact that the larger systems have available more facilities for their solution; but quality must be maintained somehow, regardless of facilities.

One example of the many and varied, often ingenious, schemes of the small system operator to accomplish this is that of an operator faced with difficulty in delivering sterile water through a new main extension. Before installation of the new main, regular bacteriological tests had indicated that the water regularly met public health standards without chlorination. When the new cast-iron extension was installed it was "sterilized" with hypochlorite and flushed, but was not to be put in service until the laboratory report showed it to be "free of *Esch. coli.*" On first test, the main was reported "contaminated." Consequently, the procedure was repeated—again unsuccessfully. Subsequent attempts were continued over a period of months before the line actually delivered water of as good a quality as that which was put into it.

Under ordinary circumstances, the obvious answer to the problem, after the initial treatment and flushing, would have been to increase the chlorination to the point where the line delivered water to the consumer with a slight chlorine residual. In this instance, however, the system was supplied by deep wells and was not equipped with a chlorinator, nor did the department wish to install one. Contamination was traced to the material used as packing for the lead joints.

Wishing to avoid a repetition of this difficulty in subsequent main installations, the operator developed a rubber packing ring to be used to prevent continued contamination from other types of packing. His invention, incidentally, is now a nationally advertised product that promises to overshadow his water business.

A paper presented on October 24, 1941, at the California Section Meeting, Fresno, Calif., by Lawrence H. Cook, Pres., Cook Research Labs., Ltd., Menlo Park, Calif.

Quality Problems

In general, the quality of water is dependent upon the presence or absence of coliform bacteria and of odor, taste and color. To be sure, there are other considerations—hardness, corrosivity, dissolved oxygen (white water) and the like—but in most instances a water is not considered objectionable until the consumers complain of odors, tastes or color. The most important factor of quality of domestic water is its bacterial condition, and, unfortunately, this is the most difficult to determine.

So many small systems, like Topsy, "jest growed," the steps of expansion being marked by the new developments applied in the different portions of the system. A number of such small systems, serving but a few hundred consumers, particularly in mountain communities, have a half-dozen or more water sources—various isolated springs from a more or less unprotected watershed—all tied in at different points. In such cases, the cost either of chlorinating at each source or of tying the sources together for chlorination at one point is prohibitive. This dilemma usually postpones any improvement program until the "powers that be" decide that the capital investment is really necessary. In the meantime, whatever treatment is done is usually accomplished by setting up barrels equipped with a hypochlorite drip arrangement at convenient points at the various sources. Such action usually results in a two-way attack on the operator—the health authorities complaining of the spotty treatment and the consumers, of the "awful" taste.

Incidentally, the hypochlorite drip method is a very useful emergency treatment measure. The procedure involves setting up, at the point of treatment, a barrel, with a wooden stopcock or other valve placed near the bottom and the opening adjusted to empty it in 12 or 24 hr. On the basis that five gallons of commercial hypochlorite will treat about a million gallons of water, dosage may be determined by estimating the quantity to be treated in one emptying of the barrel. Treatment is then effected by adding the computed amount of hypochlorite and enough water to fill the barrel.

In California's "Redwood Empire," many of the smaller systems utilize streams as a source of supply, although much of the water obtained is colored red or brown by the redwood trees. Since the redwood is one of the few trees that includes phenols as part of its internal economy, the leaching out and chlorination of these substances in the water produce tastes, which, to say the least, are weird. Experimentation with superchlorination of these supplies has indicated that a highly satisfactory bleaching effect and destruction of tastes may thus be obtained, but the treatment dictated by the finances of the plants involved is coagulation and filtration for color removal, and a minimum dosage of chlorine.

Odors and tastes in water are so closely associated that only an expert can differentiate between them. Hydrogen sulfide is perhaps the worst offender and algae the next in creating tastes and odors. Luckily, these two rarely occur together. The small operator usually is able, fairly satisfactorily, to eliminate hydrogen sulfide by arranging some sort of aeration between his well pump and booster pump, and the consumers usually become accustomed to the residual; but algae tastes and odors are different. Given an uncovered storage reservoir, a few days of hot sun and a hit-or-miss chlorination treatment, and telephone lines will burn with consumers' complaints. The discreet operator then cuts down the chlorine dosage to the vanishing point, and complaints lessen. All is well, then, until the health authorities take bacteriological samples, when the process starts over again.

Almost every water system, at one time or another, has had trouble with water carrying the rust from corrosion of mains or of consumers' plumbing. A system receiving moderately corrosive water only occasionally is likely to have more trouble than one which has a consistently corrosive supply. If, under ordinary circumstances, moderately hard water is distributed, no corrosion takes place, deposits accumulating gradually on the walls of the mains. Corrosive water softens and breaks away these deposits and the débris is carried into the consumers' services. Those consumers located on dead ends are more likely to complain of red water, as the iron dissolved by the corrosive water will have been reprecipitated because of the loss of oxygen.

Almost without question, one considers water from the melting snow of high mountains as the most nearly ideal supply, yet this water is very likely to be quite corrosive. Although its mineral content is low and it is soft, the content of free dissolved carbon dioxide and the consequent low pH are undesirable characteristics. The most practical solution is to add enough lime to the water to raise the pH slightly and to remove the free carbon dioxide. The Mokelumne River supply for Oakland, Calif., is so treated and the Hetch Hetchy supply for San Francisco is mixed with harder water from Calaveras and Crystal Springs Reservoirs to raise the pH sufficiently to prevent corrosion.

Experience in Southern California

Not to digress too far from the discussion of small systems, however, some examples from experiences in southern San Mateo County, Calif., are pertinent. San Francisco transports Hetch Hetchy water from the high Sierras through tunnels and lined steel pipe across the San Joaquin Valley, crossing the Coast Range at Livermore, going under the Bay at Dumbarton and discharging into the southern end of the Crystal Springs Lakes. In this last portion, across San Mateo County, a number of connections

are made for water districts and for Redwood City, Palo Alto and other communities. One public water district, with which the author is familiar, supplies about 300 consumers through some thirty miles of mains connected to the San Francisco transmission line at two points. This small distribution system has, of course, an excessive consumer per mile factor, long dead ends and normally has low velocities in the mains. During three months of the summer, six or eight agricultural consumers often irrigate their fields for 20 hr. a day, using half the total supply. This intermittent high velocity use stirs up the rather loosely held sediment and scale, prompting almost constant complaints by the domestic consumers. Hydrant flushing seems only to aggravate the problem, the additional draft stirring up the more distant areas, so this measure is not frequently resorted to, particularly in view of the fact that all the water thus wasted is metered and must be paid for by the district.

The operation of the San Francisco system involves alternate use of its sources. The summer supply is taken mostly from Calaveras Reservoir, a moderately hard water. Then, because surface runoff makes this water turbid and because of the desire to gain storage, winter supply includes a maximum of Hetch Hetchy water. If, however, too large a proportion of the Hetch Hetchy water is used, red water troubles result. When this water is taken off at the large lined transmission lines it is crystal clear, but by the time it reaches the distant dead ends it has changed completely. In its slow travel through the distribution system, it loosens any incrustation, attacks the iron and disperses any cemented sediment. The consumers nearest the take-off complain of dirty water, while those farther removed, where the water has lost its free oxygen content and where the iron goes out of solution as suspended iron rust, complain of both dirty and rusty water. Action on these complaints involves a high velocity flushing to clear the mains of solids so far as possible, subsequent low velocity flushing to remove the red water, and a fervent plea to San Francisco to mix a little more hard water with the Hetch Hetchy supply.

In closing, some mention should be made of the unfortunate small system operator who must contend with a supply which contains a few parts per million of iron. The best advice in such cases is that the supply be abandoned; but if this is impossible, the operator has the problem of precipitating the iron by aeration, chlorination, manganese zeolite treatment or some other process, and then removing it by settling or filtering. Usually this involves too great a capital investment and technical control for the small system, so that no action is taken. Recent applications of sodium hexametaphosphate indicate that this chemical keeps the iron in solution much longer. Perhaps its use may prove of real value to the small system operator.

Tentative

MANUAL OF SAFE PRACTICE

in

WATER DISTRIBUTION

This tentative manual was prepared by a special committee of the American Water Works Association and has been approved for publication by the Committee on Water Works Practice. It is not in final or standard form.

A critical review of and comments upon the text by any interested water works man will be appreciated by the committees.

Correspondence related to the manual should be addressed to the American Water Works Association, 22 East 40th Street, New York, N.Y.

The personnel of the committee is given on page 936.

The American Water Works Association issues this text as a "Tentative Manual." It is a manual—*not a specification.* It is tentative—*not standard.* It is intended to be a general guide to good municipal water supply distribution practice, but it is not intended to be a substitute for, nor to be superior to, competent engineering judgment. It is not designed for unqualified use under all conditions and the advisability of use of the material and practices herein specified for any installation must be subjected to review by the engineer responsible for the construction and operation in the particular locality concerned.

The discussions within the committee are not yet complete. Upon several points, the members of the committee are not in full accord. The text as it now stands represents a majority opinion as interpreted by the chairman of the committee and as edited by the staff of the A.W.W.A.

AMERICAN WATER WORKS ASSOCIATION

22 East 40th St., New York, N.Y.

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Tentative
MANUAL OF SAFE PRACTICE IN WATER DISTRIBUTION

Section 1—Scope

Considerations of safety in water distribution include sanitary hazards and structural hazards. Danger to health may result from improper attention to either or both types of distribution system imperfections.

Sect. 1.1—Definitions

The following explanations may clarify the subject matter in the sections under consideration:

1.11 *A Potable Water* is one which does not contain objectionable pollution, contamination, infection or objectionable minerals. It is a water satisfactory for domestic consumption.*

1.12 *Safe Water Distribution* involves distributing a potable water supply without endangering the quality and safety of the water for drinking.

1.13 *Sanitary Hazards* are imperfections, actual or potential, which might impair the quality of a water supply by permitting the entrance of pollution, contamination or infection dangerous to health. These may be due to imperfect design, imperfect construction or improper operation.

1.14 "*Cross-Connection:* A connection between a potable public water supply system and a secondary institutional or private (industrial, etc.) water supply system, the source of which is distinct from the public supply and from which source the water derived is distributed, under pressure, within the institution or industrial property. (Cross-connections to public water supply are recognized to be within the control of public health authorities. Reference is here made to the fact that public health authorities in some states forbid cross-connections even though the secondary supply may be considered potable and used for drinking water; in other states cross-connections with secondary drinking water supplies are permitted if an approved check-valve installation is made; and in some states

* See definitions of "potable" and "non-potable" water in the report of the Committee on Cross-Connections (Jour. A.W.W.A., **34:** 19 (1942)).

cross-connections to emergency non-drinking water supplies are permitted if chlorination equipment is installed and operative.)

1.15 "*Inter-Connection:* Any connection between the potable water distributing pipes and the drainage or waste pipes of the plumbing system.

1.16 "*Back-Flow:* The term back-flow as referred to herein means the flow of impure (non-potable or used) water, including sewage wastes or other contaminating material, into a pure (potable or non-used) water system. Such flow may be caused by gravity, vacuum or other pressure differential. The term back-siphonage has wide usage, describing one condition of back-flow due to the existence of a partial vacuum in the water distributing piping.

"Back-flow has also been used to describe a reverse flow condition in a piping system when normal service conditions are disturbed."*

1.17 *Structural Hazards* are imperfections which, actually or potentially, impair the physical structure of the distribution system. These may be due to structural weaknesses, imperfect workmanship or insufficient capacity.

Sect. 1.2—Physical Limits

These regulatory sections relate to the water distribution system from the filtered water reservoir or potable water source to the customer's meter, including potable water reservoirs, pump suction lines, potable water pumping stations, transmission mains, distribution mains and the service connections to the meter or to the curb box if unmetered.

Sect. 1.3—Correlation With Other Aspects of Water Supply

These sections anticipate similar regulatory paragraphs covering proper water supply sources and water treatment to provide a safe potable supply, specifications covering workmanship, materials and procedures to ensure proper construction, specific regulations against cross-connections within the premises of water users, and certain other items.

1.31—*Pumping Station Performance:* All pumping stations supplying potable water to the distribution system should have ample capacity and be designed to operate satisfactorily without endangering the quantity or quality of water required for the distribution system. Two or more independent sources of power should be provided.

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*The definitions for *cross-connection*, *inter-connection* and *back-flow* are quoted from the tentative report of A.S.A. A40 Committee on Air-Gaps. "Inter-system connection" is proposed as the proper term to apply to connections between adjacent municipal or public supplies. Such connections are now advocated as means of protection against complete interruption of service in one public service area when/if partial supply could be provided by use of a connection to an adjacent (and approved) public water supply system. The terms "cross-connection" and/or "inter-connection" should not be used when reference is made to connections between transmission or distribution mains of two adjacent public water supply systems.

1.32—*Water Supply Sources:* These sections assume that the water entering the distribution system has been made potable by proper treatment, or comes from a source free from any actual or potential contamination. No water shall be permitted to enter the distribution system which has not met the specifications for a potable water safe for a drinking water supply.

1.33—*Water Treatment:* All waters permitted to enter the distribution system should be purified by such treatment as may be necessary to produce a potable water. Treatment procedures should follow the methods outlined by the appropriate A.W.W.A. committees on water purification. Preferably, the water treatment should provide: (1) such chlorine residuals at the point of treatment as are indicated by experience to be adequate and (2) a stable mineral composition to minimize any tendency to corrosion or incrustation of the distribution mains.

1.34—*Control of Cross-Connections:* No actual or potential connections should be permitted between any part of the distribution system and any other water supply except another well protected potable supply. Every service connection or other water outlet should be considered a potential inlet; accordingly, every possible precaution should be taken to prevent inter-connections within the water users' premises.*

1.35—*Standpipes and Elevated Tanks:* Standpipes and elevated tanks are included as potable water reservoirs. All such standpipes and elevated tanks should comply with "A.W.W.A. Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs—7H.1-1941" (or latest revision thereof).

Sect. 1.4—Construction

1.41 *Construction Materials:* All piping used in a water distribution system should be constructed of material of sufficient strength to withstand internal and external loadings and should be of proven durability. Any material used for water distribution piping should have sufficient thickness and be of such composition as to permit satisfactory taps for service connections. A.W.W.A. and A.S.A. specifications covering certain materials are as follows:†

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* A minority report supports the use of cross-connection protective devices. See recommendation No. 1 of the Committee on Cross-Connections (Jour. A.W.W.A., **34:** 35 (1942)).

† Reference is not made to specifications for reinforced concrete pressure pipe, nor to specifications for asbestos-cement pressure pipe, because no general specifications have been promulgated by the A.W.W.A. Emergency specifications are now in preparation. Engineers responsible for water works construction may deem either class of pipe suitable for certain conditions which may be met in water distribution systems.

Specifications for Cast-Iron Pipe, Fittings, Lining and Laying

American Recommended Practice Manual for the Computation of Strength and Thickness of Cast-Iron Pipe—A.S.A. A21.1-1939.

American Standard Specifications for Cast-Iron Pit-Cast Pipe for Water or Other Liquids—A.S.A. A21.2-1939.

American Standard Specifications for Cement Mortar Lining for Cast-Iron Pipe and Fittings—A.S.A. A21.4-1939.

Standard Specifications for Cast-Iron Special Castings.

Standard Specifications for Laying Cast-Iron Pipe—7D.1-1938.

Specifications for Steel Pipe and Coatings

Standard Specifications for Riveted Steel Pipe—7A.1-1940.

Tentative Specifications for Lock-Bar Pipe—7A.2-T.

Standard Specifications for Electric Fusion Welded Steel Water Pipe of Sizes 30 Inches and Over—7A.3-1940.

Standard Specifications for Steel Water Pipe of Sizes of 4 Inches up to but Not Including 30 Inches—7A.4-1941.

Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes 30 Inches and Over—7A.5-1940

Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes of 4½ Inches Outside Diameter up to but Not Including 30 Inches—7A.6-1940

Standard Specifications for Cement-Mortar Protective Coating for Steel Water Pipe of Sizes 30 Inches and Over—7A.7-1941

Specifications for Valves, Sluice Gates and Fire Hydrants

Standard Specifications for Gate Valves for Ordinary Water Works Service—7F.1-1938

Tentative Specifications for Sluice Gates—7F.2-T

Standard Specifications for Fire Hydrants for Ordinary Water Works Service—7F.3-1940

The above specifications, or the latest revision thereof, should be employed wherever applicable.

1.42—*Construction Methods:* Construction methods should be such as to obtain sound structures and should comply with the "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1-1938," insofar as they apply.

Section 2—Potable Water Reservoirs

Sect. 2.1.—Types of Reservoirs

Potable water reservoirs may be considered with reference to the following types, depending upon service and location, namely:

2.11—Clear water storage or pump sumps on the suction side of high lift pumps:

(a) Located above ground water level.

(b) Located below ground water or lake level.

2.12—Reservoirs in the distribution system:

(a) Elevated tanks and standpipes

(b) Ground level reservoirs.

2.13—Dug or bored wells from which water may be pumped directly into the distribution system.

Sect. 2.2.—Location of Reservoirs

2.21—*Preferable Locations:* Potable water reservoirs preferably should be located above ground water level and in such location that surface water and underground drainage may be away from the structure. Ample provisions should be included to guard against the structural hazards and, more particularly, against the sanitary hazards related to location factors, such as ground water levels, movement and quality, character of soil, possibility of sewage pollution and of overtopping by floods. Sites in ravines or low areas subject to periodic flooding should be avoided.

2.22—*Proximity to Sewers and Cesspools:* A potable water reservoir should not be placed in close proximity to any large sewers carrying sewage, nor should deposits of fecal matter such as cesspools and privies be permitted near by, or on higher ground directly above, the reservoir, from which either surface or underground drainage might flow toward the reservoir. Immediate steps should be taken to remove any such conditions should they be discovered. Any sewer located within 200 ft. of a potable water reservoir should be constructed of cast iron or other durable material with watertight joints.

2.23—*Submerged Reservoirs:* Any reservoir which may be submerged by surface, ground, or flood waters should be designed and constructed with particular care in reference to watertightness. The concrete should be extremely dense and designed for low unit stresses. Ample reinforcement against temperature stresses should be provided. Some effective waterproofing either by admixture or surface treatment should be included. No openings subject to flooding should be allowed.

Sect. 2.3—Drainage

2.31—*General Considerations:* All potable water reservoirs should be protected against flood water or high-water level in any stream, lake or

other body of water. If practicable the reservoir should be placed above high-water level. Any reservoir likely to be subjected to the influence of high-water level should be surrounded by sufficient earth fill, properly protected against erosion, to keep surface water a reasonable distance from the concrete (at least 10 ft.), and the structure and all appurtenances must be so designed as to be structurally safe and water-tight.

2.32—*Adjacent Areas:* The ground surface about the reservoir should be sloped to drain or divert surface water away from the reservoir and should be so graded that no pooling of surface water will occur within the vicinity of the reservoir. The floors of any passageways, galleries, or compartments adjacent to a potable water reservoir, well or pump sump, should have free drainage, preferably by gravity to the surface of the ground or into a drainage pit equipped with a properly designed drainage pump of ample capacity and carefully maintained.

2.33—*Reservoir Drainage:* Any overflow, blowoff or clean-out pipes from potable water reservoirs should discharge freely into an open basin from a point not less than 12 in. above the top or spill line of the basin. If such drainage pipes are at any time likely to be submerged by surface or flood water, they should be provided with double check valves to guard against back-flow of contaminated water into the reservoir. The basin, if located so as to overflow above the ground surface, may be drained into a storm sewer, otherwise the basin should be drained by a reliable drainage pump as specified above. Any overflow, blowoff or clean-out pipes should be turned to the side and screened with removable 20-mesh screen to prevent the entrance of rain, dust, birds, insects, rodents and other contaminating material.

Sect. 2.4—Design

2.41—*Structural Design:* Any potable water reservoir, well or pump sump should be so designed as to be structurally safe under any combination of loadings that might reasonably be anticipated. Aboveground reservoirs should be given ample strength to withstand the internal water pressure and should also be provided with ample reinforcement to take care of contraction and expansion due to temperature changes. Underground reservoirs should be designed to withstand full water pressure on either side of the wall with no pressure on the opposite side. It is desirable that concrete walls be constructed with a high density concrete and provided with sufficient reinforcing steel and wall thickness to result in low unit stresses in order to minimize the possibility of cracks and leaks. Effective waterproofing also is desirable.

2.42—*Foundations:* Potable water reservoirs should be constructed on a natural or an artificial non-yielding foundation or especially reinforced to

prevent any settlement, likely to cause cracks or openings through which contaminated water may enter the reservoir through leakage, in such quantities as to jeopardize the quality of the water in the reservoir or the functioning of the reservoir.

2.43—*Construction Joints:* Particular care should be taken in the design and construction of potable water reservoirs to ensure that any necessary construction joints are watertight and free of any material likely to deteriorate or fail due to weathering.

2.44—*Inlet and Outlet Pipes:* All inlet and outlet pipes connecting to potable water reservoirs should be carefully supported to minimize the possibility of settlement and should be provided with a leaded bell and spigot or other flexible joint not more than 18 in. outside the reservoir wall, to prevent cracking the pipe if any unequal settlement should occur. The wall casting should be provided with suitable collars to ensure a watertight connection.

2.45—*Covers:* Suitable and substantial covers should be provided for any reservoir, elevated tank or other structure used for potable water storage, or any well or pump sump from which water is to be taken for human consumption. These should be watertight and of some permanent material, and should be constructed so as to provide drainage away from the cover and to prevent the entrance of contamination into the potable water supply. It is desirable that ample waterproofing be provided to prevent leakage through any cracking of the cover and that all openings be constructed with curb walls raised above the surrounding surface to prevent surface drainage from entering the opening. The surface of covers on potable water reservoirs, wells or pump sumps should not be used for any purpose in connection with which contaminating matter is likely to be produced.

2.46—*Manholes on Reservoir Covers:* Manholes and manhole covers, where necessary on covers over potable water reservoirs, pump sumps, or wells, should be fitted with raised watertight walls projecting at least 12 in. above the level of the surrounding earth surface, or 6 in. above the surrounding concrete surface. Each manhole frame should be closed with a solid, watertight cover, preferably with edges projecting downward at least 2 in. around the outside of the frame. The manhole covers should be provided with a sturdy locking device and should be kept locked at all times except when actually in use.

2.47—*Vents and Other Openings:* Any necessary vents or openings through covers on potable water reservoirs for water-level control gages, or other purposes, should be constructed so as to prevent the entrance of dust, rain, snow, birds, insects or any other material which might include

contamination. Any such openings should be provided with a pipe sleeve or other device making a watertight junction with the reservoir cover and extending without openings to an elevation of at least 12 in. above the surface of the cover, preferably with a stuffing box at the top. No such vents or openings should be provided near sources of dust, smoke and the like, nor where surface water might splash over and into them.

2.48—*Protection Against Weathering:* All covers over potable water reservoirs should be constructed of substantial and durable materials and should be protected against deterioration, due to weathering, by a proper protective coating or by a minimum of 18 in. of earth cover.

Sect. 2.5—Elevated Storage

2.51—*General Considerations:* Elevated potable water storage reservoirs should conform to the "A.W.W.A. Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs—7H.1-1941" (or latest revision thereof), insofar as they apply. All such potable water reservoirs should have a tight fitting cover substantially protected against deterioration. All elevated storage reservoirs should be designed to withstand maximum wind and snow pressures likely to be encountered and also should have a reasonably liberal safety factor to provide against possible earthquakes, cyclones or hurricanes.

2.52—*Maintenance and Corrosion Protection:* A routine maintenance program, including regular cleaning and painting, should be applied to all elevated reservoirs. Any tendency toward leakage should be promptly repaired. Suitable protection by painting, cathodic or other methods should be provided to reduce corrosion to a minimum.

2.53—*Air and Ground Traffic:* Every elevated reservoir should be protected against damage from air traffic, insofar as practicable, by suitable markings and lighting, and protected against ground traffic by suitable fences or barricades to avoid injury to the supporting structure by automobiles or other vehicles.

2.54—*Adjacent Structures:* Elevated reservoirs should be so located as to avoid any structural or sanitary hazards due to the too close proximity of adjacent structures.

2.55—*Operation:* Potable water reservoirs should be operated at all times in such manner as to maintain the highest sanitary quality of the water. It is desirable that baffles should be provided to prevent short-circuiting of the water flowing through each reservoir, and, where practicable, chlorine residuals should be maintained throughout the reservoir. Any deposits appearing on wall or floor surfaces should be removed promptly.

Section 3—Potable Water Suction Lines

Sect. 3.1—General: Potable water suction lines, including pump suction lines and other water mains, likely to operate under negative pressure, should be constructed with special attention to providing against settlement and to obtaining tight joints. Preferably, such negative pressure lines should be readily accessible and should be drained or protected in such manner that the pipe will not be directly surrounded with contaminated water.

Sect. 3.2—Adjacent Sewerage: No sanitary sewers and, preferably, no yard drains should be located so that sewage or contaminated water may be drained to the vicinity of any potable water suction line. Any sanitary sewer within 300 ft. of a potable water negative pressure line may properly be constructed of cast-iron pipe or equivalent material, with specially prepared watertight joints. No potable water suction line should be permitted to be operated if surrounded with sewage-contaminated water in direct contact with the pipe.

Sect. 3.3—Underwater Crossings: Pump suction and negative or reduced pressure lines carrying potable water should not be placed under streams, in which crossings the suction line may, actually or potentially, be submerged in contaminated water. Where a stream crossing by a suction line is necessary, special construction should be included to ensure against the contact of the contaminated stream water with the suction line. Preferably, there should be provided a substantial construction, such as a watertight tunnel or an outer covering with positive and continuous drainage of the space about the suction line.

Sect. 3.4—Suction Line Materials: Preferably, suction lines should be constructed of cast-iron pipe of a weight and strength equivalent to or heavier than Class 150 from "American Standard Specifications for Cast-Iron Pit-Cast Pipe for Water or Other Liquids—A21.2—1939," or latest revision thereof, with sturdy watertight joints and should be securely supported by an unyielding foundation. The pipe line should be tested for leakage and strength after construction, but, while still exposed, by subjecting the line to a water pressure of not less than 50 psi., maintained for an hour after all visible leaks have been stopped.

Sect. 3.5—Temperature Protection: Any exposed suction lines should be provided with ample insulation for heat and frost protection. Also, ample provision should be included for any expansion or contraction due to temperature changes.

Sect. 3.6—Wall Connections: Any suction lines through the side wall ro top slab of a reservoir should be constructed with a wall casting of suitable design to provide a watertight connection with the wall or roof concrete.

Also, a leaded joint or other flexible joint should be included in the suction line not more than 18 in. outside of the wall, to prevent breaking of the pipe at the wall in case of unequal settlement of the pipe, its foundation or the wall.

Sect. 3.7—Suction Lines in Trenches: If the potable water suction line, such as the line between the reservoir and the pumping station, is constructed in a concrete trench, the trench should have a watertight bottom slab and side walls, with the side walls extending at least 6 in. above the ground surface. Unless there is free surface drainage away from the suction line, the pipe trench should be covered with substantially watertight plates or monolithic concrete slabs, with manholes for access, constructed in the manner indicated for covers on potable water reservoirs. Pipe trenches within a pumping station or other building may be covered with removable gratings to permit ready access. The suction line should be placed with the bottom of the pipe at least 6 in. above the bottom of the trench, supported by substantial blocks of concrete and, where necessary, provided with insulation for frost protection. The supporting piers and the frost protection should be so constructed as not to obstruct free drainage along the pipe trench. All pipe trenches for suction lines should be provided with ample drainage to the ground surface where feasible, otherwise to a drainage sump with a suitable pump of ample capacity.

Sect. 3.8—Underground Suction Lines: Underground potable water suction lines should be constructed with particular care to ensure that contaminated water does not reach the area about the suction line and also to ensure that no leaks will occur in the line. Preferably, underground suction lines from detached wells or reservoirs should be placed at a sufficient depth below ground surface to protect against frost action and to provide some shield against surface contamination.

Section 4—Potable Water Pumping Stations

Sect. 4.1—General

Potable water pumping stations include stations pumping from well fields, from clear water reservoirs and from other potable water sources with discharge directly into the distribution system or into a reservoir supplying the distribution system. Booster pumps within the distribution system are also included. The following sections do not cover fully all details of design, construction and operation, but cover a limited number of factors which have particular bearing on distribution system safety.

Sect. 4.2—Location

In general, any pumping station, including booster stations, handling potable water should be so located as not to be submerged during any flood

or high water. Any such station located below high-water level should be provided with special construction, including bulkheads and other provisions, to prevent high water from entering the station, insofar as may be practicable.

Sect. 4.3—Wells and Well Fields

Pumping stations serving wells and well fields and discharging directly into the distribution piping should comply with the foregoing and the following sections insofar as they reasonably apply.

Sect. 4.4—Equipment

4.41—*Auxiliary Capacity:* Pumping station units and auxiliary equipment should be of ample capacity and in sufficient numbers of units to permit at least one unit being out for repairs without seriously reducing the station capacity.

4.42—*Power Sources:* All main pumping stations should be provided with auxiliary sources of power sufficient to maintain operation in case of interruption of the primary power source, or other provisions should be made to protect against interruption to water service by power failure.

4.43—*Priming Devices:* Any water used for priming potable water pumping units should be taken from the distribution system or other source of potable water and used in such manner that no dust, drippings or other possible contaminating matter may get into the water while it is being used. A properly designed vacuum type priming system may be used. Water used for priming any pumping units handling other than potable water should not be taken through any direct connection to the distribution system, but should be obtained from a tank which may be filled from a pipe discharging into it from a point at least 6 in. above the top of the tank. Auxiliary priming pumps should be used if necessary to take water from the storage tank.

4.44—*Water Lubrication:* Pump bearings located in a well below the pump room floor or in any other location likely to drip into any potable water supply should be lubricated with water taken from a potable supply. The possibilities of lubricating water dripping into the potable supply should be minimized.

4.45—*Condenser and Cooling Water:* Any water used for cooling or condenser purposes should not be returned to any part of the water distribution system. If the cooling or condenser water is to be re-used in the cooling or condenser system, the supply for make-up from a potable water system should be furnished through a storage tank with the inlet discharging through a free fall of 6 in. above the top of the storage tank. The foregoing is not intended to rule out the so-called water works type of condenser when used in water works pumping stations.

Sect. 4.5—Structural Considerations

The pumping station should be a sturdy and reasonably durable structure. The substructure should be designed to withstand all loads likely to occur and should provide against leakage, into the station, of ground water or water from any source which might cause damage to the pumping units. The floors and walls below ground level should be designed to carry the hydrostatic pressure of the maximum water level outside, with no water inside, and should be watertight. Pump foundations should be of such weight and strength as to carry the pumping equipment safely and without undue vibration. The superstructure should be of brick, stone masonry, concrete or other substantial material.

Sect. 4.6—Toilets, Washstands and Bath Facilities

All toilet, lavatory or bath facilities within potable water pumping stations should be located in well lighted and well ventilated rooms so drained that no overflowing water can reach any potable water reservoir or the area around any suction line or pumping unit. All plumbing should conform to plumbing codes approved by the proper health authorities. All toilets, urinals or shower-stall drains should be placed above the maximum possible backwater level of the sewer into which these plumbing fixtures drain, or else they should drain into a fully enclosed tight tank with a power-operated sewage ejector discharging through a connection to the sewer, with an overflow opening outside the pumping station building so arranged that no overflow water could drain into the pumping station.

Sect. 4.7—Booster Pump Stations

Pumping units located in the distribution systems to increase pressures should, insofar as practicable, comply with all of the foregoing. Particular care should be taken that these pumping units do not create a negative pressure in the distribution mains on the suction side of the station. Preferably, such booster stations should be located in rooms having floors above ground. If located in underground pits, particular attention should be given to ventilation, drainage, lighting, and to protection against flooding with contaminated water.

Sect. 4.8—General Drainage

Preferably, pump rooms should be arranged with free gravity drainage to the ground surface at a level below the station. The internal drainage, or external drainage from immediately adjacent areas, should not be dis-

charged into a sewer carrying domestic sewage and, preferably, not into any sewer. Where gravity drainage is not feasible, a sump and a sump pump of ample capacity and sturdy construction should be installed with proper automatic water level control and with an alarm system in case the sump fills to overflowing. Effective provisions should be included to protect pumping units and auxiliary equipment against damage or deterioration from water or moisture due to inadequate drainage or excessive condensation on cold surfaces.

Sect. 4.9—Operation and Maintenance

All potable water pumping stations should be properly operated and maintained. The larger stations should have a properly qualified operator supervising the plant operation at all times. Automatic operating stations should receive routine visits at least once daily. Proper lubrication should be provided at all times and any worn or broken parts should be repaired promptly. Each pumping unit should be tested periodically to ensure that it is in operating order.

Section 5—Distribution System

Sect. 5.1—General

The following sections relate to the sanitary and structural safety of the water distribution system from the clear water reservoir or pump sump of the potable water pumping station, or equivalent, to the customer's service at the meter or at the curb, including transmission mains, street mains, reservoir connections and all distribution system appurtenances, such as hydrants, valves, blowoffs, service cocks, etc. It is the intent that these sections should relate to those aspects of design, construction and operation which affect the sanitary or structural safety in respect to health hazards, but not to comprise specific or detailed specifications covering all details of materials and workmanship, or all functions of water distribution.

Sect. 5.2—Sanitary Hazards

5.21—*General:* Numerous potential hazards of potable water contamination by pathogenic bacteria, toxic materials or substances, likely to make the water undesirable for drinking, exist in water distribution systems. The operating routine should include as many protective measures as practicable properly to detect and remove or destroy any contamination which might enter the distribution system. Certain major protective measures are indicated in the following sections.

5.22—*Cross-Connections, Inter-Connections and Back-Flow Connections:*

The following principles should be given full consideration in planning future construction: There should be no physical connection between the distribution system and any other water supply, the water of which may be unfit for domestic use, or any water supply which is not checked regularly as to quality. Also there should be no physical connection (inter-connection) to any sewer, drainage line, plumbing fixture or any other connection through which any back pressure (back-flow) outside the water line or negative pressure within the water line could cause contaminating matter to enter the potable water distribution system. Any questionable connections or old connections should be carefully investigated, removed and a permanent record made of the findings.

5.23—*Dual Water Systems:* The use of two or more water supply systems, any one of which may be unsafe, should be avoided. The potable supply should include sufficient capacity for all purposes. In case a special fire system is used, particular care should be taken to identify all piping in both water systems by distinctive markings. The fire system piping should not be extended into buildings. In no case should there be a direct physical connection between the potable water supply and any unsafe or uncertain supply. If it is necessary to furnish water from the safe supply into the unsafe system, this should be done by means of a tank on the unsafe system, with the supply from the safe system discharging with a free fall into the tank from an elevation not less than 6 in. above the top of the storage tank.

5.24—*Service Connections:* Each water outlet or service connection should be considered as a potential inlet at times of reduced pressures in the distribution system or excessive pressures in the connection. Preferably, all larger service connections (1-in. or larger) should be provided with double check valves or other effective devices to protect against back-flow into the distribution system.*

5.25—*Potential Sewage Contamination:* Every precaution should be taken against the possibility of sewage contamination of potable water in the distribution system. Water mains and sanitary sewers should be constructed as far apart as practicable. Water mains and sewers should not be constructed in the same trench. Water mains, necessarily in close proximity to sewers, should be placed above the sewers and partially protected by

* The requirement of a double check valve installation on all services larger than 1-in., to protect against back-flow is not, in my opinion, the proper solution to the problem of possible contamination from the user's premises. First of all, such check valves, if even reasonably dependable, are quite costly. Second, they cannot and will not be kept in working order. Third, no check or series of checks will be a positive guarantee against back-flow. Lastly, protection against entrance of pollution from the user's premises should be made at the real and basic cause of such possible entrance of pollution, that is, the individual fixture or other water-using equipment.—*F. M. Dawson.*

being entirely surrounded by at least 12 in. of carefully compacted clay backfill. In tunnels or galleries water lines should be placed above sewer lines and the sewer lines should be cast-iron pipe (or equivalent) with leaded or other durable and watertight joints.

5.26—*Chlorine Residuals:* The treatment of water with a sterilizing agent is a desirable protective measure against small injections of bacterial contamination. Where chlorination is practiced, such chlorine residuals should be maintained at the point of treatment as are indicated by experience to be adequate, and frequent chlorine residual tests should be made at the point of treatment. Provision should be made for local disinfection in distribution systems when breaks occur or when special hazards exist.

5.27—*Vacuum Breakers on Distribution Lines**

Sect. 5.3—Distribution System Design

5.31—*General:* The design of distribution systems should include certain general provisions:

(a) A distribution system should include a proper arrangement of, and ample capacity in, larger trunk lines to ensure a supply of water to all parts of the system to meet any reasonable demand, including fire hazards, without producing a condition of negative pressure in any part of the system.

(b) All possible sources from which contamination may enter the potable water should be omitted or removed.

(c) Pipes should have sufficient structural strength and should be properly supported and reinforced where necessary to guard against structural failures with resulting sanitary hazards.

(d) Material of proper character and thickness, with a coating which will withstand service conditions, should be included to minimize the possibility of leaks or entrance of contamination due to corrosion or other deterioration with age.

(e) Any drains, such as hydrant drips or valve pits, should discharge onto the ground surface where possible or into dry pits or gravel pockets, but not into any sewer. Certain design aspects of particular significance are covered in more detail in the following sections.

5.32—*Location Records:* An accurate up-to-date record should be kept of the location of every item in the distribution system, with all mains, valves and other underground structures carefully referenced to reasonably per-

* The committee is in substantial disagreement concerning the following statement. It is included as a footnote in order that it may be fully appraised and discussed.

Air inlet vacuum breakers are desirable on distribution mains 4-in. or larger in diameter, especially in areas with considerable variation in elevations. Such fixtures should be located at the lower side of valves at frequent intervals horizontally and at each 20 ft. of difference in elevation and should be so constructed as to provide against entrance of any contaminating matter.

manent aboveground objects in order that the underground structures may be located promptly. These records should be established in accordance with "A.W.W.A. Recommended Practice for Distribution System Records—7G-1940," or latest revision thereof. Further, a similar up-to-date record should be kept of all adjacent non-potable water supply structures or pipes and fixtures containing water not regularly checked as to potability. Likewise, the distribution system records should show all pipes carrying domestic sewage or toxic industrial wastes located within 10 ft. of any element of the distribution system. These records should be readily available to all members of the water department, health officials and other interested authorities and should be revised at regular intervals.

5.33—*Depth of Mains:* All water pipes should be located at sufficient depth to protect the pipe from the direct effect of loaded trucks and at least 12 in. below the maximum frost depth of the locality, or be provided with satisfactory frost protection. In general, a cover above the top of the pipe of not less than 36 in. should be provided in any location, and this minimum cover should not be less than 5 ft. under traffic ways. Ravine and gulley crossings require special consideration with regard to frost protection and supports.

5.34—*Underwater Crossings:* In general underwater crossings may involve greater sanitary hazards than pipe lines carried across waterways on bridges or other structures. All underwater crossings should be so designed and constructed as to provide more than the usual security against structural failure or leakage through joints. It is suggested that tunnel crossings for pipe lines be given careful consideration. Valves should be provided at each end of all underwater crossings so that the crossing may be isolated in case of flood or other emergency or any trouble. Also, alternate supply lines of ample capacity should be provided to serve areas supplied by underwater crossings.

5.35—*Railroad Crossings:* Water mains crossing under railroad tracks should be especially designed to guard against loosening of joints or breaking of pipe by vibration. Such crossings, if submerged in ground or surface water, or if near a sewer, should be protected by a tunnel or outer shell so constructed as to prevent transmittal of vibration to the water main.

5.36—*Valve Locations:* Valves should be located at frequent intervals along all water mains and at such points as to permit the closing off of any section of a water main for repairs or testing without affecting water service to any extended area. An accurate and up-to-date record should be kept of all valves. This record should be duplicated and made readily available to all properly qualified water works employees. All valves should be set

and protected as specified in Sect. 11 of the "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1–1938," or latest revision thereof.*

5.37—*Valve Maintenance and Drainage:* All valves should be tested for leakage and operation by routine inspections at frequent intervals. Leaky stuffing boxes should be properly repaired. No drain from a valve or valve pit should be connected to any sewer or submerged in any ground or surface water.

5.38—*Blowoff Drainage:* Blowoffs for draining water mains should be so located that danger of contamination of the water line by back-flow will be eliminated. No such blowoff should be connected to any swer or storm drain, submerged in any surface water, or installed in any manner that will permit backsiphonage into the distribution system.

5.39—*Hydrant Location and Drainage:* All hydrants should be so located as to be best protected. An accurate up-to-date record should be kept of all hydrant locations. No hydrant should have a drainage connection directly or indirectly through a drainage pit to any sewer. Hydrants set in impervious soil may be drained into a drainage pit, 2 ft. in diameter and 2 ft. deep, with compacted coarse gravel or broken stone under and around the bowl of the hydrant up to a level 6 in. above the waste opening.

Sect. 5.4—Water Main Construction

5.41—*General:* The construction work should be so planned and carried out as to ensure a water distribution system free from leaks, securely supported to prevent settlement or breakage of pipes and thoroughly sterilized to remove all possibility of infection or contamination. All pipe lines should be protected from vibration by being surrounded by 6 to 12 in. of clay or sandy material. Rigid connections to concrete walls or other immovable objects should be restricted so as to guard against breakage due to unequal settlement. The detailed provisions in "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1–1938," or latest revision thereof, should be carefully followed insofar as they apply. The following sections indicate certain aspects of construction of particular sanitary significance.

* It seems to be rather well established in the minds of most water works men at this time that maps of the distribution system have no business in general circulation. They should be available only to trained personnel of the water company or department and not to all employees. Certainly, other interested persons, whoever they may be, do not have the practical skill to handle shut-offs when sections of mains are damaged. This fact was not so well established at the time this report was originally prepared. As a matter of fact, at that time, it was generally thought that distribution system plans should be available. At this time, it seems that the section should be eliminated or changed to read that plans should be in the hands only of designated water company employees competent to handle situations which may arise.—*C. K. Calvert.*

5.42—*Excavation:* All water line trenches should be excavated in such manner as to provide a stable foundation, to prevent contamination entering the pipe and to prevent unnecessary backfill loadings on the pipe. Bell holes should be provided to permit the making of watertight joints; unstable material should be adequately sheeted and braced to prevent caving; and the sheeting should be left in until the pipe line has been completed and satisfactorily tested and the backfill thoroughly tamped around and to a depth of 24 in. over the pipe. The details of the excavation should comply with Sect. 7 of the "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1-1938," or latest revision thereof.

5.43—*Sanitation:* Particular care should be taken to guard against the entrance of sewage into the water line trench during or after construction. All sewer lines, house connections or other subsurface drains should be located before excavation is started and care taken to prevent any accidental discharge of the contents of sewers into the trench. Adequate provision should be made for the flow of sewers, drains and watercourses during construction. All disturbed structures should be carefully restored. Proper measures should be taken to prevent urination or defecation in the trench by workmen. Any sewage matter which might be found in the trench should be carefully removed and the location sterilized with a liberal amount of chlorinated lime spread over the area. Ample provisions should be made to remove all ground or surface water from water main trenches and no such water should be allowed to enter the pipe line. Pipe laying operations should be suspended during rains or when unsatisfactory conditions prevail in the trench. A tight stopper or bulkhead of satisfactory design should be placed at the open end of the pipe at all times when pipe is not being inserted into the section already laid, to prevent the entrance of any drainage or foreign matter.

5.44—*Clean Pipes:* The interior of all pipe, fittings and other accessories should be kept free of dirt and foreign matter at all times. Each pipe, fitting or other accessory should be carefully inspected and thoroughly cleaned of any dirt or foreign matter, which might be present on the inside, before being lowered into the trench and should be kept clean during and after laying.

5.45—*Laying and Testing:* All pipes, fittings and other accessories should be properly handled and lowered into the trench so as to prevent damage to the pipes, pipe fittings and accessories or the pipe coating. Each piece of the pipe should be carefully inspected and tested for defects, and no defective pipe, fittings or accessories should be used. Materials and tests should conform to the specifications cited in Sect. 1.41, where such are applicable. The workmanship and methods of laying and jointing pipe and the setting

of valves and other accessories should comply with the appropriate sections of "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1–1938," or latest revision thereof. After laying and before completion of backfill, all pipe lines should be tested by being subjected to a hydrostatic pressure 50 per cent above normal operating pressure, maintained for 30 min. after all air has been expelled from the pipe line and all visible leaks repaired. Ample bracing should be provided at bends and at the end of the pipe, under test, to take the reaction of the test pressure so as not to endanger the stability of the pipe line or the pipe joints. The procedure and details of the hydrostatic test should comply with Sect. 15 of "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1–1938," or latest revision thereof.

5.46—*Jointing Materials:* Pipe line joints should be constructed by means of a base gasket of satisfactory yarning material followed by molten lead, sulfur jointing compound or other satisfactory compound, or portland cement, as may be specified. The yarning material should be free from oil, greasy substances or tar; should be sterilized by boiling in water, by steam pressure, by suitable chemical agents or by other suitable methods; and should be handled with care to avoid excessive contamination. It should be dry when used. Details of jointing materials and procedure should comply with Sect. 10 of "A.W.W.A. Standard Specifications for laying Cast-Iron Water Pipe—7D.1–1938," or latest revision thereof, insofar as they apply.

5.47—*Pipe Line Sterilization:* Every new water main and every repaired section of an existing water main must be cleared of all non-spore-forming bacteria by the proper application of chlorine in sufficient quantities to give 50 ppm. of available chlorine. Chlorine solution, chlorine gas or a high grade chlorine compound may be used, and should be retained in the pipe for at least three hours, and preferably longer, with a chlorine residual at the end of the retention period of not less than 5 ppm. at any point. A procedure should be used similar to that specified in Sect. 17 of "A.W.W.A. Standard Specifications for Laying Cast-Iron Pipe—7D.1–1938," or latest revision thereof. The new or repaired pipe line should be thoroughly flushed after chlorination and, if there is any question of the effectiveness of the chlorine treatment, the procedure should be repeated.

Sect. 5.5—Service Connections

Service connections may become inlets into the distribution system under unfavorable conditions of pressure differentials. Therefore, such connections may become sanitary hazards. Such service connections should be constructed of proper material to reduce possibilities of leakage due to deterioration and of sufficient size to furnish an ample quantity of water under

sufficient pressure to avoid negative pressures within the customer's premises. In general, the minimum size of pipe for service connections extending about 100 ft. from the street main to an adjacent premise should not be less than $\frac{3}{4}$ in. for any connection. The size of service should be determined by a person qualified and competent to take into account the various factors of length of service, water pressure, probable use of water within the building to be served and the probability of reduction in pipe capacity during the life of the service. In general, determination of the size of a service should follow the procedure set forth in Paragraph 604, "Size of Building Main," of *Report BMS-66 Plumbing Manual*, published by the National Bureau of Standards, November 22, 1940.

The Committee on Distribution System Safety presents this manual as tentative. It is to be noted that this tentative manual proposes that no hydrant, valve pit or blowoff drain should be connected to any sewer. Where drains are necessary, they should discharge into absorption pockets or compacted gravel or broken stone, if the soil is not sufficiently porous to receive the flow.

The committee would appreciate a critical review of the tentative manual by interested water works men.

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ABSTRACTS OF WATER WORKS LITERATURE

Key. 31: 481(Mar. '39) indicates volume 31, page 481, issue dated March 1939. If the publication is paged by issues, **31:** 3: 481, (Mar. '39) indicates volume 31, number 3, page 481. Initials following an abstract indicate reproduction, by permission, from periodicals as follows: *B.H.—Bulletin of Hygiene* (*British*); *C.A.—Chemical Abstracts; P.H.E.A.—Public Health Engineering Abstracts; W.P.R.—Water Pollution Research* (*British*); *I.M.—Institute of Metals* (*British*).

CORROSION AND CORROSION CONTROL

Soil-Corrosion Studies, 1939: Ferrous and Nonferrous Corrosion-Resistant Materials. Kirk H. Logan. J. Res., Natl. Bur. Stds. **28:** 379 (Mar. '42). Investigation of corrosion-resistant materials by Natl. Bur. Stds. outgrowth of investigation of soil corrosion begun by Bur. in '22. Article presents results of inspection of ferrous and nonferrous specimens after exposure 7 and 2 yr., resp. Data presented as weight lost and max. penetration rate, implying corrosion progress proportional to exposure duration, not generally true. Tests made at 16 sites from Md. to Calif.: 11 soils acid, with pH from 2.6 to 7.1; 5, alk., pH from 7.2 to 9.4 (one of these cinders, resistance at 15.6°C. varying from 62 to 17,794 ohm-cm.). Ferrous cast iron, buried 1½" to 4', exposure period about 7 yr. Specimens 1½" by 1' pipe, ¼" thick. High alloy—Mn 1%, Cr 2.61, Ni 15, Cu 6.58—suffered least, loss of weight in oz. per sq.ft. being 0.68 to 9.39, with 24.3 in cinders. Each oz. per sq.ft. corresponds to avg. penetration of 0.0017" (so expressed hereinafter). Low alloy, rattled, sand-coated and special process cast iron lost approx. same weight in each kind of soil, varying from 1.44 to 44.69. Depth of pits in mils (so expressed hereinafter) high alloy 22 to 58, others 25 to 192 with not much variation between types in any one soil; all types punctured in cinders. In exposing specimens and inspecting at certain intervals, in evaluating behavior of different materials and influence of various alloying elements on corrosion, important to observe whether same effects apply in each interval. Wrought iron, Cu-Mo, open-hearth iron, low-carbon steel, 4 alloy steels (2.5% Ni 1.1% Cr); 5% Cr; 18% Cr; 18% Cr 8% Ni, exposed in same soils as cast iron. 18 Cr and 18 Cr 8 Ni—loss in weight negligible, pitting unaffected. Loss in weight 5 Cr varied from 1.65 to 29.59, pitting 38 to puncture. Loss in weight 2.5 Ni 1.1 Cr, 2.15 to 37.65, pitting 14 to 145. Low carbon steel and Cu-Mo open-hearth loss in weight about same 2.6 to 35.58 each in same soil, while depth of pits varied, between and in same soil, about 10 to puncture. Wrought iron loss in weight 1.83 to 35.37, pitting 15 to puncture. From tabulated results, cinders should be avoided around any kind of metallic pipe. High-chromium steels, exposed in environments where they would be most susceptible to corrosive attack, indicate stainless steels must contain at least 8% Ni to withstand corrosion. Copper exposed for 13 yr. showed shallow metal attack but no pitting. Brass, Cu-Zn alloy and aluminum bronze showed a weight loss of about 3, no pits greater than 6; brass and Cu-Zn alloy showed selective corrosion such as dezincification. Soils contg. chlorides particularly corrosive to Cu. Cu-bearing pipes in tidal marsh soils show that corrosion rate decreases with increase in zinc content. If soil conditions corrosive to

ferrous metals but not zinc, latter metal not dependable as protection cathodically. Zinc specimens corroded under same conditions which corrode iron and steel soils—high in soluble salts and poorly aerated org. soils. Addn. of antimony to lead to improve mech. properties increased resistance to corrosion. Generally, lead corroded only slightly under soil conditions corrosive to ferrous metals, copper and zinc; after exposure in soils for 7 yr., little difference observed in corrosion resistance of wrought iron, low-carbon steel, Cu-Mo open-hearth iron or steel with 4 to 6% Cr; Cu-Ni steel, mill scale removed, showed greater resistance to corrosion.—*Samuel A. Evans.*

The Status of Cathodic Protection of Pipe Lines in 1941. Kirk H. Logan. Paper before Water Conf. Civ. Sec., Eng. Soc. of W. Pa. (Nov. 3, '41). Protection of metal by neutralization of corroding current as currently understood began approx. '10 or earlier. Data on effectiveness somewhat limited because of relatively short period of use. Theory of cathodic protection corollary to electrolytic theory of corrosion. Fundamental idea of cathodic protection superimposition of current to make corroding current equal to zero. When protective current superimposed, potential of corroding areas, or anodes, does not change materially until certain current density reached, which current density is that required to prevent corrosion. Author quotes 3 important conclusions of another investigator, Ewing, who reported: (1) protective current always causes alkali to accumulate on cathode surface, which has effect on bond of bituminous coatings and metal and has bearing on anaerobic biological corrosion; (2) potential of metal with respect to reference electrode taken alone no criterion of rate at which metal corroding; and (3) when current density exceeds protective value, log current density-potential curve straight line with negative slope. In protection of pipe lines current densities from 1 to 14 ma. per sq.ft. reported required. Most pipe line users of cathodic protection det. if lines protected by maintaining potential of line with respect to steel electrode, 0.20 to 0.25 v. neg. Protecting current for pipe lines obtained largely from power lines using copper-oxide rectifiers. Wind-driven generators sometimes used but popularity decreasing. Al, Zn, Mg anodes also used, but not extensively. Original cost of protecting apparatus for pipe lines varies from $500 to $2,000 per mi., difficult to apply to lines within cities.—*Martin E. Flentje.*

Present Status of Cathodic Protection of Pipe Lines. *Natl. Bureau of Stds. Notes.* J. Franklin Inst. **233**: 79 (Jan. '42). Use of external current applied cathodically for protecting pipe lines against corrosion first undertaken about '10 or earlier. Since then system has widely extended, especially within last 10 yr. According to recent estimate, 750 cathodic protection units, protecting 3,000 mi. of line, in operation. No. of conferences on subject between Bureau and pipe-line operators and corrosion engrs. during summer of '41 all indicated cathodic protection both practical and economical for protection of transmission pipe lines. Successful too in protecting distr. systems in few cities in which method tried. Because of interlacing networks, difficulties in protecting distr. systems much greater. Such failures in operation of cathodic protection as reported attributed to poor design and poor maint.; and since similar failures to be expected in any pioneering undertaking, not to be taken too seriously. One of the major unsolved problems is measurement of minimum current density required for protection. Otherwise, difficult to determine, except by experience, whether a pipe line over- or under-protected.—*Ed.*

Rational Approach to Cathodic-Protection Problems. G. N. Scott. Petrol. Engr. **12**: 8: 27; **12**: 9: 59; **12**: 11: 74 ('41). By math. anal. of theoretical and practical phases of cathodic pipeline protection is derived basic eq. $V_r = V_\alpha + (i\rho/2\pi) ln\ r/\alpha$ (V_r = general galvanic potential readings in mv., V = that observed at pipe or coating surface, i = galvanic current, ρ = resistivity of soil, r = radial distance from pipe center to point in test plane, and α = physical radius of pipeline). Applications discussed.—*C.A.*

Determinations of the Current Required for Cathodic Protection. S. Ewing. Proc. Am. Gas. Assn. **22:** 613 ('40). Although experience has shown that sufficient pos. current will prevent leaks in pipe lines, there is considerable disagreement as to how min. protection current can be detd. Lab. investigation shows that side reactions may cause false potential readings. Current density at which overvoltage curve (log. current density vs. potential) begins on straight line is min. current density which will prevent corrosion. Desired precision not obtained in lab. but if field data can be of similar precision will be satisfactory for practical purposes.—*T. E. Larson*.

Calculation of Current and Potential Distribution in Cathodic Protection Systems. W. F. Rogers. Petrol. Engr. **12:** 3:66 ('40). Current and potential distr. in cathodic protection systems can be calculated by means of expanded or modified form of eq. $dV = -AIdx$, where V = potential drop between earth and pipe at any point, I = current in pipe, A = resistance in ohms of unit length of pipe of given diam. and wt., and x = any distance along pipe from origin. Derivations and methods of applying formulas worked out in detail with ref. to tables and graphs of field data.—*C.A*.

Laboratory Tests of Cathodic Protection of Steel in Corrosive Solutions. W. R. Hill. Petrol. Engr. **12:** 13: 51 ('41). Results of lab. tests on cathodic protection of steel in corrosive solns. reported. Tests carried out at 20° for 6 to 649 days in 70-ml. corrosion cells provided with carbon anodes and glass tubes for introducing 50 ml. of air per hr. Current densities supplied at 20 v. by vacuum-tube rectifier were 0.1, 0.3, 1.0, 3.0, 10.0 and 30 ma. per sq.ft. Steel coupons sealed to bottom of cell were cut from 20 gage cold-rolled 0.15% mild carbon steel. Solns. used included 1.0, 0.1, 0.01, and 0.001 *N* sodium chloride; 0.1 *N* sodium sulfate; 0.1 *N* magnesium chloride; 0.1 *N* calcium chloride; 0.001 and 0.00001 *N* sulfuric acid; 0.001 and 0.00001 *N* sodium hydroxide; and sea water. Tests showed that in all cases a current density of 10 ma. per sq.ft. afforded virtually complete protection. Contrary to general experience, soln. density, composition and concn. had but little effect on cathodic protection obtained. Greater current density was necessary in solns. of high hydrogen-ion concn. but that required for complete protection has not diminished after 2 mo. Corrosion not uniform; this indicates division of surface into anodic and cathodic areas. Presence of polarization change of 0.1 v. or more above normal metal-soln. potential or, in case of sea water, appearance of calcium carbonate-magnesium hydroxide film could be used as criteria for establishing complete protection.—*C.A*.

Laboratory Tests of Cathodic Protection in Soils. W. R. Hill. Petrol. Engr. **12:** 6: 69 ('41). Lab. tests indicated that, in general, no fixed metal-to-soil potential difference associated with complete corrosion protection and that current density required for protection varied over wide range for different soils and for same soil at different moisture contents. Inverse relationship, however, existed between soil resistivity and current density. Although in some cases corrosion loss increased or at least did not decrease until current density was nearly to protective value, this does not indicate that no protection is to be preferred to partial protection, since latter helps reduce pitting responsible for pipe-line failure.—*C.A*.

Cathodic Unit Prevents Corrosion. L. M. Duryee. Elec. World. **116:** 1450 (Nov. 1, '41). Every 5 yr. Naugatuck (Conn.) Water Co. took 200,000-gal. water storage tank, 30′ diam. x 40′ high, out of service to paint inside to prevent corrosion, at cost of $1,000. Installation of cathodic protective device consuming 25 kwhr. per mo. for each electrode eliminates need for painting. Unit converts 110-v. a-c. to low-voltage d-c., using tank as cathode and three 2¼″ diam. x 7′ anodes in water. Cathodic protector develops minute plating action to give delicate mineral deposit balance on inner surface. Prelim. tests showed method would retire equip. investment in less than 4 yr.—*Ralph E. Noble*.

Cathodic Protection of Tanks—Discussion. Ohio Conf. Water Purif. 20th Ann. Rept. ('40) p. 104. A. V. Foltz: Cathodic protection system installed in wash water tank at Findlay in Mar. '38, cost being about equal to that of painting. Results completely satisfactory. Elevated storage tank similarly equipped in Apr. '40. Operating cost less than 30¢ per mo. per unit. Electrode cable broken by ice during winter. E. E. Smith: Cathodic protection has controlled pitting in 35,000-gal. wash water tank in Lima but some corrosion noted in bottom of riser. Consideration being given to installation of electrode in latter. O. B. Hess: Recent inspection of elevated tank at St. Clairsville, equipped for cathodic protection, in excellent condition. Ice action caused electrode to break loose during winter. Operating cost 31¢ per mo. R. V. Aicher: Cathodic protection devices used at Huron on 2 tanks and on filter wash water troughs, results being satisfactory. Ice action causes some trouble. R. C. Bardwell: Of 8 installations in C. & O. R.R. tanks, 5 were effective and 3 not entirely satisfactory. Lee Harvey: Only trouble with wash water tank at Conneaut was removal of paint, which had been applied under adverse conditions. Breaking of electrodes occurred in winter, so tank was not filled until needed. George D. Norcom: Preliminary reports on several installations in tanks of Federal Water Works Co. satisfactory.—*R. E. Thompson.*

Cathodic Protection to Prevent Corrosion of Gas-Well Casing. Wm. E. Huddleston. Oil Gas J. **39:** 52: 59 ('41). Within certain limitations, cathodic protection may provide economical means of controlling corrosion of gas-well casing. Design problems include power, source and detn. of necessary load requirements.—*C.A.*

Cathodic Protection of Condensers and Coolers Utilizing Brackish Bay Water. W. A. S. Wright and J. H. Brooks. Proc. Am. Petrol. Inst. **21:** III: 83 ('40). Corrosion of tubes in surface condenser operating on brackish bay waters very greatly reduced by: (1) replacing red brass by Admiralty metal tubes; (2) installing cathodic protection by imposed current of 2.5 amp. per 1,000 sq. ft. of surface; (3) using strainers to trap foreign particles; and (4) establishing more rigid inspection and cleaning. Details of cathodic protection system given.—*I.M.*

Clear Varnish for Internal Protection of Drinking Water Tanks. Anon. Ministry of Aircraft Production, Material Spec. D.T.D. 234 H.M. Stationery Off., London ('40). Specification for clear varnish to be used for internal protection of drinking water tanks states that material must be free from antimony, arsenic, barium, copper, mercury, lead, or zinc, and must not contain more than 1% by wt. of cobalt. Must be of such consistency that can be applied by brushing, and must be suitable for heating at temp. not above 170°C. for not more than 2 hr. Bending test to det. flexibility and adhesion, and tests to det. resistance of varnish to chlorinated water, and to distd. water described.—*W.P.R.*

Surface Protection of Metals. W. Wiederholt. Z. Ver. Dtsch. Ing. (Ger.) **85:** 451 ('41). Describes various methods of coating metals to prevent corrosion. Metallic coats, org. coats or non-metallic inorg. coats may be used. Before application of protective coat, metal must be cleaned mechanically, chemically or electrochemically. Application of different types of protective coat dealt with.—*W.P.R.*

Influence of Stress on the Corrosion Pitting of Aluminum Bronze and Monel Metal in Water. Dunlap J. McAdams and Glen W. Geil. J. Research, Natl. Bureau of Stds. **26:** 135 (Feb. '41). Article reports second of series of tests investigating cyclic stress on corrosion of metals; first being on steels, both being on corrosion in well water. Al bronze investigated had composition: Cu, 87.7%; Al, 10.5%; Fe, 2.64%. Composition of monel used mainly: Ni, 67.5%; Cu, 29.5%; Fe, 1.76%; Mn, 0.95%, C, 0.16%. Tensile properties, for (1) Al bronze and (2) monel metal, were: tensile strength—(1) 101,900 psi., (2) 127,200 psi.; elastic limit—(1)

36,900 psi., (2) 84,500 psi., Johnson's limit—(1) 41,900 psi., (2) 95,000 psi. Rate of corrosion of steel in well water controlled by conditions at cathodes, in Al bronze and monel it is anodically controlled and, in this type corrosion, much more erratic. Position and form of corrosion pits in steels, in aerated well water, little affected by microstructure, pits being free to assume forms detd. by corrosion conditions. In Al bronze, pitting much influenced by microstructure. Numerous excellent pictures given of pits under 500 and 1,000× magnification. After corrosion of steel in well water for only 4 and 4.7 days, pits much larger and lowering of the fatigue limit much greater than after corrosion of Al bronze in well water for 66 and 88 days. Pits in monel formed after corrosion in water for 122 days much smaller than formed in steel within few days. Effect of cyclic stresses on corrosion studied for various stresses and various cycles of application of stress (from once per day to 10,000 cycles per min.). Cyclic stress tends to increase both size and sharpness of the pits. Steady stress tends to accelerate corrosion of Al bronze but has little apparent effect on corrosion pitting of monel metal.—*Martin E. Flentje.*

The Corroded Bronze of Corinth. EARLE R. CALEY. Proc. Am. Phil. Soc. **84:** 5: 689 ('41). Anals. of several corroded bronze objects from site of ancient Corinth indicate that they originally contained about 14% of tin and little or no lead. Unusually poor state of preservation of bronze objects found on this site attributed to high proportion of chlorides in soil and in water of Fountain Peirene. Basic cupric chloride present in appreciable amts. in corrosion products. Photomicrographs of typical structures in metallic core and patina of a 5th cent. strigil handle reproduced. These suggest that intergranular corrosion preceded general attack and, moreover, commenced in layers approx. parallel to axis of handle. Action attributed to presence of segregated bands of nonmetallic impurities or of tin-rich phase in original material. Handle evidently fabricated by hot working at above 590°C. Mechanism of corrosion discussed at considerable length. Statement of Pausanias concerning treatment of Corinthian bronze in water of Fountain Peirene critically examd. and concluded that the successful working of this high-tin material was wrongly ascribed to character of water rather than to particular heat-treatment employed.—*I.M.*

Comparative Value of Arsenic, Antimony and Phosphorus in Preventing Dezincification. W. LYNES. A.S.T.M. Preprint No. 44 ('41). Tests made on effect of arsenic, antimony and phosphorus as inhibitors of dezincification of 70 : 30 brass and Admiralty brass showed that about 0.03% of any of these elements suppressed loss of zinc in test solns. (cupric chloride 5, hydrochloric acid 5%) without effect on tensile, impact, or endurance properties. Results described from point of view of uniform corrosion, pitting, intercrystalline corrosion, stress-corrosion, corrosion-fatigue and erosion-corrosion.—*I.M.*

Condenser Tubes and Their Corrosion. CHARLES W. E. CLARKE, A. E. WHITE AND C. UPTHEGROVE. Trans. A.S.M.E. **63:** 6: 513 ('41). Brief review of development of condensers for steam prime movers given, and some problems connected with them discussed. Answers to questionnaire sent out to no. of U.S. concerns, relating to design of condensers and choice of materials, given in tabular form; data obtained indicate that tubes of Admiralty metal, aluminum brass, and cupro-nickel most likely to give good service. These materials therefore tested in miniature condenser duplicating service conditions as closely as possible. Impingement test also made using river water preheated to 90°–110° F. (32.2°–43.3° C.). Concluded that for specific water conditions used, aluminum brass superior in corrosion-resistance to other materials tested; alloys of this type investigated conformed to anal.: copper 75% min., tin 1.25% max., aluminum 1.75–2.50%, zinc remainder. Grain-size *per se* does not appear to be controlling factor, and hard-drawn or annealed material may show equally good corrosion-resistance. Internal stresses sufficient

to produce cracking under std. A.S.T.M. mercurous nitrate test do not apparently have any decisive influence on performance of tubes, but stresses of this order should be avoided if possible. All good-performance tubes contained traces of phosphorus, but no particular effect can be ascribed to this element. Arsenic contents over range 0.01–0.07% give equally good results. Proper mfg. procedure undoubtedly important factor in production of highly corrosion-resistant aluminum-brass tubes.—*I.M.*

Some Timely Suggestions for Combating Corrosion in Industrial Process Piping. H. J. Bartlett. Valve World. **37**: 133 ('40). Causes of corrosion and use of 18-8 molybdenum stainless alloy steel, monel, pure nickel, "Everdur," nickel-resist cast iron and of iron for mfr. of valves and fittings, and corrosion resistance of these metals under various corrosive conditions discussed.—*C.A.*

Corrosion of Turbine Blades by Trickling Steam and Steam Containing Sulfur Dioxide. F. Lüben. Wärme. (Ger.) **63**: 136 ('40). Results given of tests on turbine blades of various alloy steels subjected to action of steam and of steam contg. sulfur dioxide introduced by treatment for removal of oxygen from feed water. Armco iron, chromium-molybdenum steel, and 5% nickel steel badly corroded, but 14% chromium steel, moderately alloyed stainless chromium-molybdenum steel 13/2, and highly alloyed stainless chromium-nickel-molybdenum steel 18/8 suffered little or no corrosion. —*W.P.R.*

Characteristics of Microbiological Deposits in Water Circuits. W. J. O'Connell Jr. Proc. Am. Petrol. Inst.—*III Refining*. (May 19–22, '41). Outline of theories offering possible explanations for some types of corrosion in water circuits, description of bio-fouling process, and anals. of characteristic deposits given. Importance of clean surfaces prerequisite to successful application of corrosion prevention and control methods stressed. Biol. approach emphasized to extent knowledge of ecology, morphology, and physiology of specific and group organisms held most important in anals. of corrosion problems. Emphasis placed on correlation of related phys., chem., electro-chem., bio-chem., and bio-phys. phenomena. Illustrative references to chlorination for controlling microbiol. growths given, with comment on interrelation of concrete and metal corrosion, and on problems of maintg. capac. in various types of water circuits. Need for corrosion control in clean refinery water circuits stated. pH adjustment, true scaling elimination, maint. of uniform surfaces, and development of protective coatings considered essential after clean water-circuit surfaces obtained.—*Ralph E. Noble.*

Scale and Corrosion Control in Water and Brine Systems. J. A. Holmes. Refrig. Eng. **431**: 145 (Mar. '42). Molecular dehydrated polyphosphates added to make-up water in ratio 1 to 5 ppm. prevent $CaCO_3$ and iron deposits (scale) where water is recirculated and cooled by spray pond or tower. Org. materials also help not only by stabilizing effect similar to phosphates but coating or staining effect to arrest or retard scale crystal formation. To test water for scale-forming properties: Test for hardness by soap method. To 2nd sample add small quant. pure $CaCO_3$, heat to temp. of circulating water. After standing 15–20 min., with occasional shaking, again make soap hardness test. If less, then water is scale-forming. If more, it is corrosive or aggressive. Difference between the 2 hardnesses tends to show amt. of corrosive properties present. 3 adaptable methods for prevention: (1) Good results with chromates if percentage make-up is low and water not further used for domestic consumption or not subsequently in contact with edible products. (2) Use alk. materials to increase pH to point where water slightly scale-forming. Sometimes enough caustic soda, soda ash or lime used. Stabilizing chems. then added to prevent scale and system thus kept clean. (3) Heavy dosage of molecular dehydrated phosphates used to prevent iron corrosion. If water very corrosive, however, better to combine alk. and phosphates—former to eliminate corrosion and latter to pre-

vent scale through too much alkalizing material. Above applies to iron and steel. For zinc, desirable to keep CO_2 and chlorides of circulating water low as possible. Copper usually quite noncorrosive, yet pH should be slightly above 7.0 and CO_2 kept low as possible. Most cooling towers and spray ponds develop algae or slime growths. Chlorine, copper sulfate and potassium permanganate or derivatives used to remove them. Chlorophenate treatment satisfactory. 1 lb. added to 5,000–15,000 g. make-up water 2 or 3 times wkly. Some condenser systems develop iron bacteria, usually from certain well waters. Chlorine or chlorophenate added at bottom of well every 2 or 3 days or once per wk. usually eliminates them. When iron bacteria slime formed throughout system and less prevalent in well, then treatment added at surface.—*Ralph E. Noble.*

Scale Formation in Water Heaters and Methods of Prevention. J. M. KRAPPE. Purdue Univ. Res. Series No. 74 ('40). Tests made to det. effect of temp., nature of surface, velocity of water and type of heater, on formation of scale in water heaters. After each test, observations made on amt. and nature of scale, and points in heater at which most scale deposited. Gas-fired domestic heaters of storage and continuous-flow types tested. Results considered in relation to hardness of water used, anal. of which given. Found that rapid increase in rate of formation of scale occurred when temp. of water rose from 140° to 180°F. Scale formed at same rate on smooth surface such as monel metal as on rougher surface of galvanized iron. High velocity of water reduces formation of scale at any temp. At 180°F. deposits of scale may obstruct outlet pipes from heater before enough scale formed in heater to reduce thermal eff. or to interfere with operation. At temps. below bp. of water, temporary hardness in form of calcium bicarbonate responsible for most of scale formed. Addn. of sodium hexametaphosphate may be satisfactory for preventing scale if distributed efficiently; types of plant for adding material discussed. Metaphosphates with low soly. in water can be placed directly in waterline to insure even distr. of small quant. required. Mech. and chem. methods for removal of scale described and discussed.—*W.P.R.*

Inhibiting Scale Deposition From Heated Water. CYRUS W. RICE. U.S. Pat. 2,258,260 (Oct. 7, '41). Method of inhibiting, in vessel such as boiler, contg. heated water, scale formation, from Ca and Mg compds. in water, involves treating Ca and Mg compds. present, in substantial entirety, with colloid dispersion of globulin reactive with Ca and Mg compds. and prepd. for such reaction with at least one peptizing acid such as H_3PO_4 or lactic acid and further reaction with water-sol. alk. reagent.—*C.A.*

CHEMICAL FEEDING, CONDITIONING AND SEDIMENTATION

Lime. OLIVER BOWLES AND D. M. BANKS. U.S. Bureau Mines Information Circular, I.C. 6884 (Oct. '41). Lime essential raw material for numerous commodities. May be defined as CaO resulting from heating $CaCO_3$ to temp. at which CO_2 is removed. Term applies also to slaked or hydrated lime. Limes classified according to composition: (1) high Ca, contg. $\not< 90\%$ CaO and 0 to 5% magnesia; (2) low-Mg lime, contg. 5 to 25% magnesia; and (3) dolomitic or high-Mg, contg. 25 to 45% magnesia. Hydraulic lime, similar to natural cement but with higher Ca and lower Al content, results from calcination of limestones with enough argillaceous matter to form substance that will set under water. Commercial limes composed of CaO, anywhere from 0 to 45% MgO, and generally $< 5\%$ impurities. Lump lime retains same form as limestone after calcination, but porosity increased greatly. When water added, hydrated lime formed and considerable heat evolved. High-Ca lime expands greatly when H_2O added and much heat generated; dolomitic limes slake much more slowly, generate less heat and expand less to give corre-

spondingly smaller vol. yield. Rate of hydration depends also on porosity of lime. Quicklime exposed to air absorbs CO_2 and H_2O—"air-slakes"; occurs in 2 steps: (1) absorption of water and (2) displacement of water by CO_2. Chem. and phys. properties of lime which det. its adaptability for various processes and products subject of much scientific study. Deposits of limestone occur in every state of U.S. and in '40 were utilized in every state except Del., N.H. and D.C. Discussion given of character and locations of limestone in various regions of U.S. Lime enters 3 large fields of utilization—bldg., agric. and mfg. In '40, 31% of value of lime mfrd. went to bldg. and 60% to chem. and mfg. processes, with 8% going to agric. 34% of lime used in '40 was $Ca(OH)_2$. Discussions given of qualities desired in many uses: bldg., agric., metallurgy, glass, refractory brick, paper, etc. '40 production about 63% of total plant capac.; value, $33,956,000 Table given showing kinds of lime produced in '38–'39 in U.S. by states and counties where production exceeded 500 tons, with location of producing areas. Lime made in pot, shaft and rotary kilns. Hydrated lime prepared by crushing CaO as it comes from kiln, slaking it and classifying fine powd. thus produced by screens or air separators to remove any core or overburned lime. Kind of lime used in chem. processes depends on purpose for which it is used—under some conditions either high-Ca or Mg lime can be used with equal success; under others Mg is undesirable. Only useful constituent in lime for water softening is CaO, and for this purpose quicklime for water softening should contain 90% available CaO on sample taken at point of mfg. (hydrated lime must contain at least 68.1%), and be substantially free of core, ash and dirt and be capable of disintegrating, in water, into a suspension of finely divided material. Circular contains considerable addnl. information of interest to lime users.—*Martin E. Flentje.*

Copper Sulfate Water Treatment Feeder. Anon. Lead. **11:** 6: 2 (Nov. '41). Several years ago, Atlanta, Ga., W.W. developed continuous $CuSO_4$ feeder which has proved efficient, economical and permanent. Constr. and operation simple. Feeders mounted outdoors at influent and effluent ends of mixing chamber. Outer shell of feeder consists of std. 3′ length of terra cotta pipe, 24″ in diam., set with bell at top, in 4″ of concrete grout. Cylindrical lead container having bottom but no top fits into upper 18″ of terra cotta pipe. Lower 18″ filled with sand topped with 3″ concrete on which lead cylinder rests. Thick-walled 1″ lead pipe runs from bottom of container out through side of terra cotta to point of application. To prevent stoppage, perforated lead baffle fitted over inlet to pipe in bottom of container. Container filled with random-size dry $CuSO_4$ crystals, into which water drips through pressure reducing valve and small orifice fed from $\frac{3}{4}$″ supply line, thus forming uniform satd. copper sulfate soln. Soln. flows out through lead pipe to point of application. Calibrated needle valve, which admits water through orifice, readily controls amt. of soln. Metal cover protects apparatus.—*Ed.*

Electric Dose-Meter for Alum Sulfate. G. M. Bartenev. Vodos. Sanit. Tekh. (U.S.S.R.) **16:** 3: 18 ('41). Electrometric apparatus based on increase in cond. of water with dissolved alum constructed by Rublevskaya water station, with continuous indications and direct reading mg.-per-l. scale. Calibrations easily checked (every day) for 0 point, when untreated water flows through both arms; dose of dry alum introduced into reagent jar and reading made in 3 to 4 min. Sensitive mirror galvanometer used.—*C.A.*

Floc-Forming Chemicals. L. B. Miller. Paper Tr. J. **112:** TAPPI Sec. 100 ('41). Discussion of suitability and limitations of floc-forming chems. used to condition water for paper mfr.; conditioning the water will aid in setting sizes, retaining fillers, removing color, and purifying boiler water; floc-forming chems. also used to clarify white waters in save-alls and to treat waste waters before discharged. Concn. of alum

added and pH value affect floc-forming capac. of alum; at low concns. pH must be carefully controlled to obtain formation of floc; curves given showing time required to produce floc with different concns. of alum and at different pH values. Qual. of floc and conditions for floc formation vary with aluminum compd. used and are affected by character and concn. of soluble electrolytes in water or added with compd. Where acid salts of aluminum used, conditions of floc formation governed principally by negative ion added; with sodium aluminate, however, negative ions already present in water will have greater effect. Alum and sodium aluminate studied by electrometric titration with caustic soda and with hydrochloric acid; known quant. of substance to be titrated placed in container, small known amts. of alkali or acid added and pH value detd. after each addn. by means of appropriate electrode. Curves obtained indicated that alum formed floc over broader pH range than did sodium aluminate under same conditions. When sodium aluminate titrated with hydrochloric acid, floc formed has compn. more closely approxg. pure aluminum hydroxide than floc formed from alum and alkali, and, therefore, has different density and rate of settling. Data plotted showing specific effect of different anions on two concns. of aluminum ion, and comparison of curves obtained shows marked effect of anions on formation of floc with alum. To det. effect of calcium and magnesium salts present in hard waters, soln. of sodium aluminate titrated electrometrically with calcium salt and with magnesium salt. Calcium salts had little effect, but presence of magnesium sulfate resulted in finely divided floc containing magnesia and alumina which settled slowly. Therefore concluded that, in waters of exceptional hardness, magnesium salts present would not cause floc formation with sodium aluminate at high pH values. Manganese should be removed from water before it is used in paper-making industry. Trivalent iron and chromium gave results similar to those of aluminum salts. In case of iron, floc formation began at lower pH than with aluminum salts (sulfate being used in both cases); thus ferric sulfate can be used in more acid solns. than can alum. Ferric floc does not redissolve at high pH as does alum floc, so that it can be used over broader ranges of pH. Chromium salts too expensive for use. Copper sulfate (which may be added for control of algae) titrated electrometrically with alkali. The curves obtained show that small addn. of alkali causes a pronounced increase in pH to value of 5.1, where floc first appears with concn. of copper salt chosen. Basic floc formed at low pH values with copper sulfate more stable to heat than floc formed in more alk. solns. Graphs and figures of exptl. results given.—*W.P.R.*

Properties of the Floc in Water Purification With Bentonite. E. M. BEAVERS AND F. K. CAMERON. J. Phys. Chem. **46:** 93 (Jan. '42). Microscopic study of floc formation in bentonite suspensions has confirmed conclusions previously drawn from macroscopic sedimentation behavior that the smaller the avg. particle size of bentonite before pptn., the fleecier the floc formed with given amt. of coagulant and the slower the settling rate. Flocs formed from suspensions of small avg. particle size less dense (more highly solvated) and larger than those formed from suspensions of greater avg. particle size; rate of settling of former therefore slower. Desolvation (dehydration) of individual particles would greatly increase floc density, decreasing floc size and increasing rate of settling. Particle size of 4 samples studied 0.235 to 0.033 μ and asymptotic "total floc volume" under exptl. conditions used, 65 to 300 ml.—*Selma Gottlieb.*

Conditioning Water With the Spaulding Precipitator. E. NORDELL. Paper Tr. J. **112:** TAPPI Sec. 221 ('41). In Spaulding Pptr. water treated with lime or with lime and soda and mixed, by means of mech. agitators at bottom of tank, with sludge which has been previously formed. Mixt. then rises and comes into contact with suspended sludge. Rate of flow of liquid decreases as it rises in tank, so that particles of sludge not carried over with effluent at top of tank. Advantages

of process over older continuous process are: period of retention reduced from between 4 and 8 hr. to 1 hr.; supersatn. prevented by contact with sludge blanket, and recarbonation therefore unnecessary; and larger size of pptd. particles enables coarser sand and, consequently, higher rates of filtration to be employed in filters. Various designs of pptrs. shown in figs. Deg. of reduction of calcium and magnesium hardness may be varied by varying dose of pptg. chems.; calcium carbonate alky. can be reduced to 2 gpg. or less, and by using larger doses of lime, magnesium can be removed, as hydroxide, down to min. of 1 gpg. Costs of treatment can be reduced by recovery of lime from sludge; as lime added ppts., equiv. amt. from water, amt. of lime recovered will equal twice amt. originally used. Turbidity and color efficiently removed. Tastes and odors can be removed by applications of powd. activated carbon in pptr.; 33–40% less carbon needed than when added to water in settling tank. Silica can be removed from water by adsorption on hydrated oxides of metals such as magnesium, iron and aluminum, added in small quants., to sludge.—*W.P.R.*

Studies on Water Treatment by Coagulation. E. Orosco, E. Frias Rocha and E. Goulart de Andrade. Revista Munic. de Engenharia. (Braz.) **3:** 27 ('39). Authors emphasize advantages of using lab. exptl. equip. capable of giving a continuous numerical record of changes which take place during coagulation and sedimentation in order to avoid use of indeterminate expressions, such as "rapid flocculation," "good size floc," etc., commonly used to describe progress of treatment. Result obtained by use of photoelec. device, made integral part of coagulation apparatus. Device indicates changes in degree of dispersion of suspended particles by measuring changes in light-transmitting properties of liquid being treated. In expts. described, output of photoelec. cell measured with galvanometer, calibrated to read in "lux" (international illumination units). Photoelec. cell placed 12 cm. below surface of water. Relationship between lux units and turbidity detd. from exptl. observations. Curves obtained by plotting time versus lux units indicated that, in general, coagulation proceeds in 3 stages: (1) short period, after addn. of coagulant, in which no marked changes occur; (2) definite formation of floc which allows larger amts. of light to be transmitted by liquid; and (3) slight decrease in amt. of transmitted light as result of breaking up of floc due to prolonged agitation. Information given by this type of curve of value in detg. proper paddle velocities and length of flocculation period. Sedimentation curves indicated that, in general, settling tendency of floc greatest during first 2 min. after paddle motion ceased. Another signif. point in sedimentation curve was at 10-min. mark. Results obtained in industrial installations showed that reading of 160 lux (equivalent to a turbidity of 7 ppm.) in less than 10 min. of settling indicated satisfactory treatment. Sedimentation curves proved of particular value in studying effect which variations in pH, nature and amt. of suspended matter, and kind and dose of chem. used, had on coagulation. Procedure was as follows: pH of each of 8 portions of turbid water adjusted to cover suitable pH range for coagulant used. After 15 min. agitation, at the proper paddle velocity for water being treated, sedimentation curves plotted. From these curves, 2- and 10-min. readings obtained in order to show on one graph relationship between pH and lux units for each of the two significant time intervals. pH range in which 10-min. curve fell above 160 lux line interpreted to indicate pH zone of efficient coagulation. Optimum pH for given set of conditions found to correspond with pH of max. clarification as given by 2-min. curve. Expts. repeated to obtain 3 more sets of data for same water, using different amts. of coagulant. From information given by 4 performance curves, new graph prepared in which 3 curves shown. One of these curves indicated relationship between coagulant dose and lowest pH in zone of effective coagulation, while other two showed same relationship for optimum pH and for highest pH in effective coagulation zone. Graphical information ob-

tained indicated that, using aluminum sulfate, optimum coagulation pH shifts toward acid side while effective pH zone becomes narrower as coagulant dose decreased. New series of expts., similar to those previously described, made to det. effect of variations in water turbidity on coagulation. Results indicated that pH range for effective coagulation became wider as initial turbidity of water decreased, down to a certain point. Below this, effective pH range diminished for waters of lesser turbidity. In same manner, expts. made to det. effect which nature of suspended material had on coagulation indicated that the greater the density of suspended matter the faster was the settling rate of floc, and that the addn. to turbid water of 10 to 25 ppm. finely ground inert material of high density made possible marked saving in coagulant needed for comparable treatment results without addn. of foreign material. Studies also made using iron and mixtures of iron and aluminum salts as coagulants. Equip. and procedure used proved highly satisfactory because of facility in which exptl. conditions could be controlled and recorded and because of good correlation observed between exptl. and large scale results.—*J. M. Sanchis.*

Water Chlorinator. Clair V. Swearingen. U.S. Pat. 2,257,865 (Oct. 7, '41). Chlorinator provided with fragile and nonmetallic Y including depending shank and first and second branches, outlet member for chlorinated water, resilient slip-sleeve coupling connecting outlet member to shank, source of water supply, resilient slip-sleeve coupling connecting first branch to source of water supply, Cl conduit, resilient slip-sleeve coupling connecting second branch to Cl conduit, Cl conduit comprising transparent, inspection portion, removable guard means housing Y and couplings, and means for supplying Cl to Cl conduit. Y may be formed of glass.—*C.A.*

WELLS AND GROUND WATER

Water Supplies. Necessity of Looking Ahead With Respect to Our Ground Water Resources. W. D. Gerber. Ill. Munic. Rev. **21**: 17 (Jan. '42). Limit to ground water supplies now being forcibly brought to attention of munic. and industrial official as well as private owners. Beginning at ground surface, unconsolidated materials generally designated under broad name of drift. Recharge of storage areas of drift wells can come only through direct percolation of rain and snow water or by lateral movement from more or less distant absorption area. Some question as to depth to which such percolation goes. If thin streak of clay interposed somewhere between ground surface and absorption area and storage zone, little water gets through. For lateral movement must be some force to make water flow through subsurface material. If absorption area some miles away will take long time for water to reach point of extraction. When well shows signs of decline in productivity, common practice to put down another of even greater capac. if possible. Demand always for more and still more water so more and more wells constructed, with result that all wells in area keep going down. Memory cannot be counted upon to remember changing conditions. Written record kept from day to day will be most valuable document in future.—*H. E. Babbitt.*

Pattern of Ground-Water Flow and Solution. Roger Rhoades and M. N. Sinacori. J. Geol. **49**: 785 (Nov.-Dec. '41). Intensive geol. investigations in connection with design and constr. of dams and other eng. works established common existence of deep bedrock soln., which has occurred well below water table. Although this deep flow and soln. entirely harmonious with hydr. principles, important aspect of problem of optimum depth of ground water flow and soln. is matter of *adjustment* of subsurface circulation. As this adjustment becomes more perfect, deep flow and soln. progressively diminish, and flow and soln. in upper levels of zone of satn. increase correspondingly. In latter

stages of cycle, cave formation probably occurs at higher levels by concn. of lateral flow through high-level master conduits. In earlier stages, flow not concd. but distributed through entire verticle sec., orientated along arcuate paths which descend deeply before recurving upward to point of discharge. —*Ralph E. Noble.*

Chemical Composition of Ground Water. M. R. Huberty. Civ. Eng. **11:** 494 (Aug. '41). Ground waters roughly grouped into 3 classes. Pore water is held between grains in alluvium and sedimentary formations; fissure water exists in joints and fissures of rock masses; and cavern water is found in solution caverns and in openings existing in lava formations. As yet identical terms for chem. compn. of water not universally used by both engrs. and chemists. Engrs. prone to use parts per million and grains per gallon which are gravimetric measurements of salts present, but not measures of chem. values. Chemists have long used term "milliequivalents per liter" to express ionic concn. of various constituents. Recently term "equivalents per million" proposed. Presence of large percentage of Ca and Mg in water looked on with disfavor by industrial engr. Irrigationists favor hard waters as they tend to keep soils permeable. Boron essential to plant growth. Flood waters usually of relatively low salt content compared with those of low stream flow. In utilization of ground water for irrigation usually trend toward increase in salt content of ground water. Although much work done on effects of salts on plant growth, no definite limit can be set, as many factors modify tolerance limit.—*H. E. Babbitt.*

Ground-Water Temperature on Long Island, New York, as Affected by Recharge of Warm Water. M. L. Brashears Jr. Econ. Geol.. **36:** 811 (Dec. '41). Ground water generally more economical than surface water for cooling purposes because of lower temp. Because of favorable conditions on L.I., many supply wells drilled for cooling purposes. Temp. of ground water on L.I. normally 15° cooler than surface water. Water table in area of 45 sq.mi. in western L.I. below sea level in '33. To prevent further overdevelopment, N.Y. State Wtr. Power & Control Com. required that ground water pumped for cooling purposes from wells constructed since '33 be returned to ground. Amt. of recharge during cooling season increased from about 0.5 mgd. in '33 to 30 mgd. in '40. Temp. of water returned to ground ranges from 2° to 20° higher than temp. of water pumped from ground. Return of warm water causes rise in ground water temp. and this decreases advantage of using ground water for cooling purposes. Amt. of rise of temp. apparently varies chiefly with rate of recharge, temp. and length of period of operation. U.S. Geol. Survey observed ground water temps. periodically at about 350 wells since '36. Return of warm water caused a rise of temp. as much as 20° at some of pumping wells, said in one instance to have caused increase in cooling costs of \$300-\$500 per mo. Observations show that gradual rise of ground water temp. occurred in considerable part of western L.I., which has resulted in subsequent loss of plant eff. and increase in costs for plants using water for cooling purposes.—*Martin E. Flentje.*

The Geologist and Sub-Surface Water. E. J. Kenny. J. Roy. Soc. (N.S.W.) **74:** 283 ('40). Sub-surface water defined as all water existing within rocks of earth. History of obtaining water by various types of wells sketched. Search in Australia for artesian water began in 1880. Today about 2,000 flowing bores within Queensland and New South Wales limits of Great Australian Artesian Basin. Sub-artesian water (i.e., water which must be raised to surface by artificial means) of greater importance than artesian water since it is used to serve needs of larger area and pop., although yield of artesian water from bores may be very great. Persistent diminution in discharge from artesian bores in Australia led to detailed statistical and geological investigation of resources. Occurrence of sub-surface water depends on permeability of rock in which found·

capac. of transmitting water depends largely on shape, size, and arrangement of pore spaces. Sub-surface water may be divided into: (1) ground water which is not under pressure above that of atmosphere at its upper surface—will not rise in well or bore, and includes water present in shallow drifts in valleys of streams; and (2) pressure water, confined beneath impervious stratum under pressure above atmospheric, and will rise in bores. Pressure water includes artesian water which is under sufficient pressure to be forced above the surface and sub-artesian water which must be raised to surface by artificial means. Water-bearing formations in New South Wales and their yields described.—*W.P.R.*

An Unusual Source of Water Supply. J. E. Howard. Coal Age. **46:** 50 (Sept. '41). From coal mine at Lochgelly, W.Va. water seeps through sub-surface rock to walls of mine shaft on which are cut niches or rings leading to sump below. Pump raises water to 30,000-gal. raw water tank on hillside above tipple. Water heavily charged with dissolved iron bicarbonates causing redness on contact with oxygen. Lime-soda ash treatment used. Clear water drawn from top 12″ outer cone of Spaulding precipitator at 60 gpm. through two 54″ steel pressure filters to storage and chlorinated.—*Ralph E. Noble.*

Artesian Water in the Coastal Area of Georgia and Northeastern Florida. V. T. Stringfield, M. A. Warren and H. H. Cooper Jr. Econ. Geol. **36:** 698 (Nov. '41). This, one of most productive artesian areas in U.S. By flow or pump, wells yield at least 180 mgd. Remainder used for different industrial, public, and domestic supplies or discharge to waste from flowing wells. Eocene Ocala limestone principal water-bearing formation at 200-500′ depths. Everywhere within 25-30 mi. of coast, wells ending in Ocala limestone overflow at surface except in few small local areas, and in or near Savannah, Ga., where well flow ceased because of large vol. withdrawal. Piezometric surface at similar to original level except coastward slope steepened and large depression cones developed thereon around Savannah and Fernandina, Fla., by large vol. withdrawals. Field tests in vicinity of Savannah indicate transmissibility coef. of water-bearing limestone about 230,000; less around Fernandina. Shape of piezometric surface and information on quant. of water taken from wells indicates coefs. around Brunswick, Ga., and Jacksonville, Fla., much larger. Total dissolved solids in Ocala water ranged from $<$ 175 to 500 ppm. Although Ocala limestone contains salt water in region north and south of coastal areas in question, samples of water from the Ocala therein show no evidence of salt water encroachment. In localities such as Savannah, however, where large withdrawal has formed large cone in piezometric surface, encroachment will occur if cone extends to area where salt water present in the formation.—*Ralph E. Noble.*

The Chief Types of the Artesian Waters of the Great Hungarian Plain and Their Suitability as Geological Indicators. Elemér Szádeczky-Kardoss. Bányász. Kohász. Lapok. (Hung.) **74:** 305 ('41). Chem. compns. and geol. origins of various waters shown in tables. Following types found in Hungary: (1) waters contg. 10-20 g./l. solids with NaCl dominant component, originating from Miocene or older horizons; (2) waters contg. 4-6 g./l. solids, with both NaCl and $NaHCO_3$ dominant salts, coming from older Pliocene layers; (3) waters contg. $<$ 2 g./l. solids, with $NaHCO_3$ dominant salt, having 2 sub-classes: (a) 1-2 g./l. solids, originating from Middle Pliocene and Lower Levantine layers; and (b) with $>$ 1 g./l. solids, coming from Newer Pliocene, Upper Levantine and Pleistocene horizons. —*C.A.*

Air-Lift for Artesian Wells. Anon. Wtr. & Wtr. Eng. (Br.) **36:** 591 (Oct. '41). Self-contained and independent water supply provided by artesian well, and compressed air as pumping agent has many advantages. Air compressor can be used for other purposes; all moving plant is at ground level; and compressor can be installed some distance from well. Layout and principle of operation of air-lift shown diagrammatically and described in detail.—*H. E. Babbitt.*

Rehabilitating Old Wells at Camden, N.J. W. M. Lewis. Am. City. **55:** 4: 73 (Apr. '40). Gradual decrease in production capac. of seven 15-yr. old wells led Camden, N.J. to undertake rehabilitation of these wells resulting in restoring 95% of original capac. Hard deposit on screens had accumulated through years and closed shutter openings making satisfactory cleaning almost impossible. Work was done on only 2 wells at a time to keep service interruption at minimum. Procedure followed was first to remove pump, break up scale deposit with mild explosive, then liquefy solid matter with chem. treatment speeded up by introducing steam through a steam line from a portable boiler. Flow of steam continued for several hours until water was near boiling. Pump then replaced, well pump clear until litmus paper test showed negative. New 18" silicon bronze lining screen (not available in this size at time wells were originally built) was installed, followed by regravelling and development to max. capac. obtainable. Successive tests to check capac. made at intervals during renovation. Construction of 2 new wells demonstrated results gained from progress in construction methods since wells were first installed. One improvement is use of smaller casings and screens. Original wells had 38" outside and 26" inside casings with 26" screens, whereas in new wells, 26" outside and 18" inside casings with 18" screens were used. Outside casing now sealed throughout length with cement to prevent seepage of undesirable waters into water-bearing formation. Study of capac. figures for old and new wells show considerable yield increase as result of reconstruction and this, of course, is reflected in lower power consumption. —*Arthur P. Miller.*

Maintenance of Water Wells. Clyde R. Harvill. Southwest W. W. Jour. **23:** 2: 13 ('41). Unclogging of screens and locating and correcting of breaks in casing causes most work. Formations on screens may be removed by change in velocity of water. In recent years, 2 new methods used: (1) 10 to 20% muriatic acid containing inhibitor to dissolve scale; and (2) solid carbon dioxide to evolve large quantities of gas to dislodge scale. 4 methods of correcting breaks given.—*O. M. Smith.*

Subsurface Survey Provides Water Supply Data. Anon. Eng. News-Rec. **128:** 413 (Mar. 12, '42). Subsurface survey in Springfield, Mass., made possible by W.P.A., undertaken for purpose of obtaining data for land reclamation, but threat of war and vulnerability of near-surface mains and reservoirs resulted in scope being extended. In addn. to more than 900 borings, traveling seismological observatory has been used to record veloc. of sound waves sent out from underground blasting stations, through which location and character of formations beneath surface discovered. Ground water source discovered under city which could be made available promptly in event of damage to present supply obtained from reservoirs.—*R. E. Thompson.*

Forests and Water. Aug. F. Meyer. Gas u. Wasser. (Ger.) **83:** 321, 459, 474 (July 6, Sept. 14, Sept. 21, '40). First part comparison of runoff and its delay from two watersheds in same district, one of 4.2 sq.mi., that is fully timbered, and other of 11.2 sq.mi., with only 22% of area timbered. Timbered area found, over 11-yr. period, to have runoff only 2% larger than that of partially timbered area. Plotting precipitation and runoff per sq.mi. on time and on mass diagrams, shown that delay in runoff is very small in both watersheds and only very slightly larger in timbered area. Difference is much less important than is generally assumed from theoretical considerations. Second part studies on velocity of penetration of rainfall to enrich ground water storage. Data on monthly rainfall and avg. el. of ground water level for 22 stations in forested areas given. Show that, generally, ground water level rises in winter and drops in summer. Shown too that, with few exceptions, summer rainfall does not penetrate to ground water but is used up during growing season by plants and by evaporation. Winter rains penetrate to ground water level, from 3' to 20' below surface, in

1 to 2 mo., time depending on local conditions.—*Max Suter.*

Underground Storage for Floods Assures Army Camp Water Supply. CLARENCE G. BEARDSLEE. Eng. News-Rec. **128:** 406 (Mar. 12, '42). Camp Cooke (Calif.), in which 35,000 men will ultimately be quartered, located on 92,000-acre reservation. Most promising source of water supply Santa Ynez R., 900-sq.mi. drainage basin having produced annual runoff varying from 46,000 to 349,000 acre-ft. during past 37 yr. Larger floods have flowed into sea without restraint, except for Gibraltar Dam which stores water for cities of Santa Barbara and Montecito. Prior claims amt. to about 23,000 acre-ft. annually. To assure dependable supply of 6,000 acre-ft. per annum (estd. desirable ultimate camp supply), group of 5 wells located in westerly half of basin where water table ranges from 5 to 25′ above mean sea level. Underground could not be relied upon in dry yr., nor was there assurance against salt water incursion in such yr. Accordingly, low impervious barrier some 3,000′ long built on subsurface blanket of clay across neck of river basin about 1 mi. from beach, including 2 dikes and central or channel section 1 100′ wide. Two rows of Wakefield timber piling driven into fill and well down into impervious clay, and concrete slab poured to provide spillway lip. Well pumps deliver through common discharge line to booster station, whence 24″ concrete main leads to two 4-mil.gal. concrete tanks from which there is gravity service to all parts of camp.—*R. E. Thompson.*

The Ranney System of Underground Water Collection. ANON. Engineering. (Br.). **152:** 461 (Dec. 12, '41). One of earliest applications of Ranney system made at Sunbury Cross, Eng., in '34 in connection with London water supply. Ranney water collector consists essentially of vertical well closed at bottom and provided with series of horizontal perforated collecting pipes radiating from it into water-bearing strata. Depending on size of well from 10 to 20 collecting pipes can be installed which may extend to 300′, although, in general, lengths from 100 to 200′ have been used. —*H. E. Babbitt.*

Outlines of Underground Water Supply in England and Wales. F. H. EDMUNDS. Wtr. and Wtr. Eng. (Br.) **43:** 185 (Midsummer '41). England and Wales receive ample rainfall, amounting to over 2,000 gpd. (Imp.) per capita in England and 7,000 in Wales. Surface water constitute chief supplies in Wales and north and west of England. London district obtains 84% of its supply from such supplies. Nevertheless, underground water serves several important areas. Total daily supply from underground sources lies between 400,000,000 and 500,000,000 gal. (Imp.) Return of rainfall to atmosphere termed water cycle. Relative proportions of evaporation, transpiration, direct runoff and net intake difficult to assess. Percentage of rainfall retained in ground is small. Rocks comprising earth's crust are of 3 chief kinds: igneous, sedimentary and metamorphic. Numerous more or less colloquial terms applied to some kinds of rock. Hard sandy shales in west of England are "shillet." In Midlands similar material called "bind." Sandy shales in north of Britain are "fakes," and blue shales are "blaes." In Midlands fireclay is "clunch." Stiff blue clay known in many districts as "gault." Capacity of rock for retaining water depends solely on its porosity but freedom of movement of water within rock controlled by permeability. Underground water, in general, flows more slowly than surface water and movement should not be regarded as along restricted channels. Weak limestones, chalk in particular, absorb much water in small pores. Many south coast towns obtain supplies from chalk. Permeability may be lost or may improve in course of time, and wells in limestone tend to improve as time goes on. Capillary fringe water does not include all that is held in rocks by capillary attraction, for it does not include any that is discontinuous with that in the zone of saturation. A water table is by no means flat, but reflects in some degree contours of land surface

about it. Some idea of water table in North and South Downs, Salisbury Plain, and Chiltern Hills obtained by correlation of water levels in wells in chalk. Construction of reliable maps of water tables frequently not possible because of lack of information and a difficulty of geologic origin, in which each permeable bed has its own water table independent of any other. The Great Oolite Series of the Midlands is formation where this occurs. In districts where vertical sequence of permeable and impermeable beds is present, each permeable stratum may give independent water table. Water in upper stratum said to be perched. Perched conditions common. Considerable no. of springs harnessed for water supplies, as at Portsmouth and Weymouth. Chalk countryside provides many examples of temporary springs, but distinction between temporary and permanent springs not absolute. Large springs break out at Ewell, giving a max. daily flow of about 8 mgd. (Imp.) and, at Fetcham, other springs of same order arise. Division of England and Wales into water-yielding and non-water-yielding areas, based wholly on distribution of chief geological formations gives inadequate picture of conditions. Survey for underground water resources would probably reveal no. of water horizons now known only to local inhabitants. Article proceeds to describe in detail groups of water bearing formations. *Discussion. Ibid.* **43:** 244 (Aug. '41). W. S. BOULTON: Exhaustive expts. have shown that capillary fringe, even in most favorable rock material for capillary action, never extends higher than few feet above water table; consequently, when it is many feet below surface, it can have no practical effect on surface waters or vegetation. H. F. CRONIN: Flow of Thames bears out author's statement that as much as 95% of rainfall may be lost by evapn. Loss not due, entirely, to evapn., for much absorbed by vegetation during late spring and summer months. No practicable method of extracting large vol. of water held in clay has been suggested. Numerous wells in chalk around London bear testimony to necessity for avoiding sites where chalk overlaid by considerable thickness of tertiary beds since failure of well will result from compression of fissures. H. J. F. GOURLEY: Author's statement that "movement of water by capillary action. . . negligible as far as water supply is concerned" leads to corollary that water works pumping cannot desiccate countryside, and fluctuations in underground reservoir can have no influence on agric. operations. Use of gravel strainers most satisfactory means of excluding sand from wells. Velocity of exit of water from sand must be kept within safe limit. Water in Dunton wells leaves sand at 40 gal. (Imp.) per sq.ft. per hr. without drawing out fines. R. C. S. WALTERS: Author does not make clear what is meant by a large or small quant. of water. Important that any reader should apply definitions of large and small in relative sense only to each part of the country discussed, and not to country as whole. Author states that large storage reservoirs not employed with underground water works, but there are cases where wells are used for replenishing impounding reservoirs. Misleading to state that most productive underground sources give small daily yield compared with major storage reservoirs. Many, if not most, small impounding reservoirs yield less than 1 mgd. (Imp.). Chance single reading of rest level [el. of ground water table] sufficient for practical eng. requirements [despite author's intimation to contrary]. Author attaches too much importance to rest level. To engr. pumping level of consequence. No practical use served in water works through separating water contours in strata of only few feet in thickness. "Dryness of synclinal area" cannot be taken too literally, for Gander Lane well as Cheam, which gives quite a good yield, is in syncline. *Author's Reply:* To question as to whether worthwhile splitting hair in definition of water table so as to leave little saturated rock in basal portion of overlying capillary zone, answer is that there is little or no appreciable difference between definition advocated by Boulton and that given in paper so long as attention confined to permeable rocks in common acceptance

of term. Dryness of deep coal mines shows that weight of cover is great factor in preventing circulation along joints. Differentiation of geologic and eng. approach [as brought out by Walters] seems more apparent than real. Readings of all water levels of fundamental importance. Statement that too much reliance should not be placed on single measurement does not imply that measurement is valueless. Words "large" and "small" unusually difficult to define and need be interpreted from context. *Discussion. Ibid.* **43:** 314, 341 (Nov., Dec. '41). E. A. CRISP: Why not call water which penetrates upper layers of soil, "intake," rather than "net intake?" Use of term "net" might be thought to imply another intake, which is not the case. Definition of permeability not satisfactory, because condition of strata where well is sunk cannot always be used to describe part or whole area of same strata. If rate of pumping "gentle," will be same whether automatically or manually controlled. Control or capac. of plant should not cause high velocity of flow in rocks. Plotting of water tables matter of measurements of levels of wells over wide area taken over long periods. Extension of piped water supplies invariably leads to existing wells being filled in with rubbish. Therefore important that no. of existing wells be retained. Owners will co-operate. J. KENNARD: Many cases can be cited where lining of well has been limited to few feet, and even when unstable nature of upper beds seems to demand considerable depth of lining, necessity to seal off effectively any possibility of surface water finding its way behind tubes to unlined portion of well often completely overlooked. From a well sunk few years ago in Essex, supply of 15,000 gal. (Imp.) per hr. being obtained from chalk, where it is covered by only 48′ of clay and other deposits. Notwithstanding to contrary, rest-water level rises to within 6′ of surface and drawdown remains steady at 26′. W. C. KNILL: Importance of correct identification of strata passed through by a well, recording of depth of changes in strata and care to ensure that water levels are measured accurately not always realized. In entering depth record, not only depth below datum, but O.D. (Ordinance Datum) level is entered. EDGAR MORTON: Practical test of permeability to be found in deg. to which any stratum will yield water whether for purely domestic or for public water supply purposes. Certain depth of saturated permeable rock below min. hydraulic gradient essential to produce necessary pressure head to induce flow at spring. Dip of permeable strata probably has more influence on movement of ground water than author supposes. Water gradient commonly influenced by dip, gradient being steeper against dip than with it. Author's theory that anticlinal folding increases permeability while synclinal folding has opposite effect apt to be misleading because inference is that boreholes sunk along top of anticlinal folds will be likely to prove more prolific than those sunk into bottom of synclinal troughs. Where permeable strata pass underground beneath covering of impermeable rocks, hardness and salinity tend to increase in proportion to distance from outcrop. D. HALTON THOMSON: Bottom of old wells in all probability close to lowest natural water level, so that this can be obtained approx. at any time by measuring depth of well even if it is full of water. Near max. levels, observations should be taken during spring season after wet winters. Author refers to remarkable springs at Bedhampton. New spring appeared there in '19, on open ground, showing no previous sign of unusual conditions. Daily yield rose to 500,000 gal. (Imp.). Tube thrust into heart of spring could be raised about 9′ above spring level before flow of water ceased indicating local pressure. About 3 mo. later similar test showed pressure had decreased to about 3′. *Author's Closure:* Full glossary of terms would be most valuable, but definitions liable to various interpretations. "Net intake" preferable to "intake." In larger sphere, "intake" has other meanings. Closing of wells, owing to spread of piped supplies, may involve serious loss of information necessary to scientific investigation of hydrogeology of country. In virtually homogeneous formation

remains true that "dip of strata by itself has little effect on circulation of underground water." Generalizations regarding extent of potable artesian and subartesian water must be liable to local exceptions.—*H. E. Babbitt.*

London's Tube Wells. ANON. Civ. Eng. (Br.) **36:** 440 (Apr. '41). Substantial quantity of water supplied to London from individual, private wells. Declaration of war necessitated shelving of planned investigations of this source of supply. Question one of greatest importance as it infers necessity of preservation of purity of water supply. Water wells of London fall into 3 categories: (1) those drilled only in clay and which draw their water from some sandy measure in that formation; (2) those that pass through clay and derive water from underlying chalk; and (3) those drilled even deeper to greensand below. Deep wells that penetrate clays and enter water-bearing chalks and greensands must come under heading of tube wells. Continuation of protection of lower water-bearing strata will depend on continued resistance of steel pipe and cement. Real problem of tube wells in London resolves itself into ascertaining what is condition of those wells not in use. Owners of abandoned wells reaching chalk or lower should not be allowed to permit continuation of undesirable state of affairs. In this way underground sources would be adequately protected against poln.—*H. E. Babbitt.*

The Subterranean Water in the Libyan Desert. B. HELLSTRÖM. Geogr. Ann. (Swedish) **22:** 206 ('40). Direction of flow of ground water in sandstone underlying Libyan desert and position of main intake beds detd. Certain depressions found, in which wells, if sunk to sufficient depth, should yield large quants. of water. Water-bearing capac. of different kinds of sandstone detd. Velocity of flow of water in sandstone very low. Method for raising pressure of artesian water locally decided to be uneconomical. Artesian pressure over large dist. might be increased by raising Aswan dam and thus preventing or reducing discharge of ground water into Nile at Dakka. —*W.P.R.*

STREAM POLLUTION AND ITS CONTROL

Industrial Stream Pollution Problems. RICHARD D. HOAK. Chem. Indus. **49:** 170 (Aug. '41). Ohio River Board of Engrs., '36, listed priority uses of Ohio R. as: (1) public health, (2) drainage, (3) navigation, (4) industry and (5) recreation. Natl. Resources Com. suggested functional problems in drainage basin study as: flood control, irrigation, water power, navigation, soil conservation, beach erosion control, small projects for agric. and grazing, public water supplies, poln., recreation and wild life, and hydrologic data and investigations. Three major sources of stream poln. are: munic. sewage, mining waste and industrial waste. About 75% of sewage of country produced in area roughly from Chicago to St. Louis and northeastward to Atlantic coast. Mining wastes consist of acid drainage and culm from coal mining regions east of Miss. R.; brines from mid-continent, Gulf Coast, Mich. and Calif. oil wells; debris from hydr. mining operations of Calif. Prior to sealing abandoned bituminous mines, equivalent to 2,700,000 tons (est.) 100% H_2SO_4 discharged annually into U.S. streams. Culm and silt from wet cleaning of anthracite. blanket stream beds and kill aquatic life. In '38 10,000,000 bbl. (est.) brine discharged daily by oil industry. Some flows into streams. Industrial wastes may be: (1) org., from milk product plants, beet sugar factories, tanneries, canneries, meat packing, breweries and distilleries, paper and straw-board mills, laundries and textile or dye works; (2) toxic. from metal plating wastes, metal mfg., gas or chem. plants and coal or other mines; also (3) inert, as from water softening plants, oil wells, saw-mills and gravel pits. Harmful to waters for public use are org. material, active inorg. chems.,

inert substances and bacteria. Org. material from domestic sewage and industries processing animal or vegetable substances are highly putrescible and constitute most serious type of poln. Latter depletes oxygen content below needs for plant and animal life, and sets up nuisances of taste and odor inimical to or dangerous for domestic, recreational or industrial use of the water. Inert substances mainly objectionable because they blanket stream beds thereby smothering aquatic life, increasing cost of water purif., reducing navigable capac. and recreational use. Most bacteria in streams harmless yet potential danger exists from relatively short lived pathogens. Cysts of *Endameba hystolytica*, cause of amebic dysentery, amazingly resistant to common sterilizing agents. Bacteria increase directly with org. content of streams unless killed by toxic substances. Important factor in natural purif. Stds. of cleanliness proposed in Pa., suggested to recognize 3 classes: (1) those preserved in nearly natural condition and reserved for water supply; (2) those used for sewage disposal after treatment of sewage, and for water supply after treatment of water; (3) those used for sewage disposal after such treatment of sewage and industrial wastes as is necessary to prevent nuisance. No single std. can apply to all cases. Allowance of waste poln. should consider natural purif. capac. of stream under dry and wet weather flow conditions and uses to which stream is to or may be put. Maint. of normal aquatic life and prevention of nuisances depends on D.O. content of water. Std. generally accepted by public health authorities is that, when oxygen content of stream is always greater than oxygen demand and never less than min. of about 4 ppm. (roughly 50% of satn.), favorable conditions should be maintd. where sludge deposits are eliminated from channel. U.S. Public Health Service investigations, '23–'27, showed that sewage-pold. streams can be treated in modern purif. plants to produce effluents meeting Treasury std. if coliform content of raw water does not exceed approx. 5,000 per 100 ml. Std. would vary somewhat according to local conditions of drought or excessive poln. Interstate Com. on Del. R. Basin and Ohio R. Valley Water Sanitation Compact examples of co-operative interstate effort to abate stream poln. Variety of waste treatment processes discussed. Ests. of cost of a poln. abatement program require intensive study. Most recent and complete one for country at large made by Special Advisory Com. on Water Poln. of Natl. Resources Com., '39. Capital expenditure of $2,000,000,000 (est.) required to abate major part of water poln. over period 10 to 20 yr. Effective only if operated and maintd. at annual cost about $240,000,000. Since natl. stream poln. is one of results of industrial expansion, and its soln. exceedingly complex due to cumulative munic. and industrial neglect, no abatement program should be attempted until carefully examd. in light of its impact on natl. economy.—*Ralph E. Noble.*

Industry Abates Stream Pollution. HAYSE H. BLACK AND CLARENCE W. KLASSEN. Sew. Wks. Eng., *Part I.* **12:** 74 (Feb. '41); *II.* **12:** 170 (Mar. '41); *III.* **12:** 215 (Apr. '41). Industry has indicated willingness to accept industrial waste treatment as another competitive process. Active co-operation of industry in providing facilities for recovery from or treatment of industrial wastes constitutes admirable response to public demand for clean streams. Considering unsolved industrial waste problems remaining, reasonable to expect active research will develop recovery or treatment processes economically feasible. Coincident with continued research, it is incumbent upon organizations administering anti-stream-poln. laws to become familiar with intricacies of industrial waste problems. Should be recognized that losses sustained in liquid wastes frequently not apparent to those primarily interested in production of established product. Mutual understanding is prime requisite in soln. to industrial waste problems.—*Ralph E. Noble.*

Water—A Natural Resource. GUY R. SCOTT. (*Staff Report.*) Sew. Wks. Eng. **13:** 30 (Jan. '42). Status of existing poln. controls indicate needs for streams con-

servation. Water and sewage treatment methods must be considered remedial measures which do not lighten stream load. These man-made processes developed to protect community health and well-being. Comparable progress, however, not shown in ind. waste treatment. Processes must be developed to return streams to natural purity economically. Although assistance hitherto available to towns in establishing sewage treatment, similar help not available to industry responsible for town's growth. Since '36, T.V.A. conducted stream poln. surveys to det. future control needs, assisted by 7 state health depts. and U.S.P.H.S. Work included studies of 4 critical sections on Tenn. R. and tributaries. Weekly samples examd. and results tabulated for 1 yr., usually. All industries surveyed and data obtained regarding amts. of wastes. States' agencies given full access to these studies and success of plans developed will depend on states' interest. Unless regulations and sound admin. policies adopted, Tenn. Valley likely to become as grossly pold. as other ind. drainage areas.—*Ralph E. Noble.*

637 Sewage Plants Under Construction During 1941. MORRIS M. COHN. Sew. Wks. Eng. **13:** 74 (Feb. '42). Increase of 43 plants over yr. before. One-third of constr., 216 plants, in defense works. Includes army camps, navy bases, marine barracks, air fields, field gunnery schools, bag loading and ordnance plants, military hospitals, arsenals, defense housing projects, aviation and aircraft factories, powder and shell loading plants, shipbldg. yards and others. All states involved. New plants totaled 561, replacements 7, enlargements 58 and repair 18. Approx. 5,850 in munic. service. Ill., N.Y., Tex. and Calif. led in plant constr. Size varied from $20,000,000 projects of N.Y. City—Bowery Bay, Coney Is., 26th Ward and Jamaica, to $1,000,000 project at Hammond, Ind., to pocket-sized plants in small towns of 200-300 pop. like Madison, Va., Smithland, Iowa, etc. In co-operation with Govt., location of military projects and types of treatment not listed. By end of '41, approx. 58,500,000 persons served by sewage treatment facilities, excluding 2,000,000 by defense works, as compared with 55,000,000 in communities at end of '40. Cost of '41 sewage plant constr. somewhat uncertain due to absence of accurate figs. on large no. and inability of state san. engrs. to provide this information on both munic. and defense projects. Incomplete data, however, indicate $60,000,000 involved. This amt. detd. by weighting available cost and pop. figures totaling over $41,000,000 for 5,230,000 pop. reported in periodical's census return. Impossible to interpret trend in treatment types because of variety of plants under constr. Accurate to say munics. and Govt. showed complete independence in choice of treatment method. Treatment definitely not hit-or-miss but met approved stds. of various state health agencies, according to local problems and diln. factors involved. Census data, basis of this report, made possible only through full co-operation of all 48 state san. engrs. Census tabulation given in detail.—*Ralph E. Noble.*

A Chemical Method for the Determination of B.O.D. DALE W. JOHNSON AND H. O. HALVORSON. (*Published in abstract only.*) J. Bact. **42:** 145 (July '41). 5-day B.O.D. accepted as std. measure of strength of domestic and industrial wastes. This measure, however, not entirely satisfactory, since many variables exist in method of detn. Consequently, different labs. may report conflicting strengths on same sample. In case of many industrial wastes, B.O.D. results unreliable because bacteria may not be able to attack certain types of org. matter under conditions of detn. Shown that iodic acid can be used for quant. oxidation of org. compds. This acid used to oxidize org. matter and ammonia values detd. Knowing size of sample and that nitrogen is not oxidized by iodic acid, amt. of latter used and oxygen required can be calcd. Then, knowing amts. of oxygen required and of nitrogen present, B.O.D. can be derived. By this method, strengths of wastes can be detd. in less than 3 hr. as compared with 5 days by std. Also gives more accurate value of org. content and check results can be obtained by different labs.—*Ralph E. Noble.*

Effects of Dilution Water on Biochemical Oxygen Demand of Sulfite Waste Liquor. GEORGE MARTIN AND E. P. MILLER. Sew. Wks. J. **13:** 659 ('41). B.O.D. of sulfite-waste liquor detd. with 5 different Wisconsin R. waters, Nichols-Lea fortified diln. water and standard bicarbonate diln. water. Actual population equiv. of 100-ton sulfite mill will vary from 283,000 to 579,000 depending on river water used. Fortified diln. water gave 314,000 pop. equiv., but if seeded with fresh river water gave 471,000. Bicarbonate diln. water gave only 69,000 and of no value for this waste. 10- and 20-day B.O.D. curves of waste must be made to interpret pollutional load. Martin and Miller recommend that sulfite wastes be dild. with stabilized river water into which it is dumped.—*C.A.*

Before the Horse Is Stolen. *Editorial*· MORRIS M. COHN. Sew. Wks. Eng. **13:** 139 (Mar. '42.) Tenn. Valley studies of potential ind. waste poln. estab. new pattern in preventive sanitation. Due to rapid urbanization and great growth of Am. ind., streams pold. to point of nuisance and health hazard before action taken to correct sins of poln. Hitherto, specialization in cure rather than prevention. No longer need to practice such neg. poln. control. Recently, Wis. Supreme Ct. upheld state health dept. order requiring city to treat its sewage, not because spread of disease *had* occurred but that it *might* do so. Ruling pointed out function of health dept. to prevent epidemics rather than correct them afterwards. Court said, "locking barn after horse stolen may be alright in some fields, but would be nothing short of criminal in field of pub. health." T.V.A. shown it practical to prevent poln. before occurrence. Since '36, stream poln. surveys carried out in 4 critical sections of Tenn. R. Valley to det. future needs of river and tributaries. Health depts. of interested states and U.S. Pub. Health Service co-operated. Industries transplanted into valley, seeking abundant cheap power and favorable labor mkt. More will come. These businesses will bring poln. which might duplicate conditions in other overworked streams. Studies made to det. nature and amts. of wastes and means to prevent their discharge. Resulting data offered to all states. Hoped uniform rules and control measures will be estabd. Tenn. Valley program adventure in foresightedness and demonstrates principle of poln. prevention rather than cure after menace of water supplies, recreational areas, fish-growing waters and community values.—*Ralph E. Noble.*

How to Avoid Water Pollution Suits. LEO T. PARKER. Sew. Wks. Eng. **13:** 157 (Mar. '42). Damage suits arising from pold. water may incur heavy financial-time losses and inconvenience. Certain types of poln. considered legal nuisance, entitling damaged party to recover damages irrespective of whether poln. resulted from negligence. In other cases, must show poln. through negligent acts to obtain favorable verdict. *Law of Damages.* (McCourt *v.* City of Covington; 143 Ky. 484). Does not make city insurer. Damaged party must show constr. method unsafe or permitted condition likely to pol. water. *Nuisance Defined.* Anything which annoys or disturbs one in free use, possession, enjoyment of his property or renders its ordinary use or occupation physically uncomfortable may become nuisance, and may be restrained. (Henderson *v.* Sullivan; 159 F. 46, 16 L.R.A., N.S., 691). Under all conditions all persons and firms must use their property in non-nuisance way to other owners. Courts consistently held property owner sustaining legal nuisance entitled to recover damages. Such nuisance abolishable by appropriate laws. Courts recognize marked distinction between poln. of small non-navigable stream and large tidal navigable bodies of salt water. Bed of stream and waters owned by riparians. Bed of salt waters and waters themselves owned and controlled by state for use and benefit of public, subject only to navigation. State dets. use of navigable streams, subject always to right of public. Through legislative branch, state also may det. amt. poln. permitted, provided landowners between low- and high-water mark not injured. *Law of Tidal Waters.* (Hampton *v.* Watson; 89 S.E. 81) Suit filed against city to recover damage to oyster bed by

poln. of large tidal navigable body of salt water. Higher ct. held city not liable, saying, as state holds tidal waters and beds for pub. benefit, city has right to use Hampton Creek for removing refuse and sewage to sea so long as not pub. nuisance. *Fails to Prove Damage.* (Helton *v.* Luse and Fosdick Drilling Co.; 147 S.W. (2nd) 831 (Feb. '41)) Plaintiff charged oil drilling co. damaged his property by discharging water into ditch tributary to stream flowing through farm. Ct. held oil co. not liable because 175 oil wells and 3 refineries drained thereinto. Plaintiff suggested no method by which damages could be ascertained. *Damage to Trees.* (Phillips Petroleum Co. *v.* Mangan, 114 Pac. (2nd) 454 (June '41)) Property owner may sue and recover damages for injury to trees by pold. water. Damages allowable are difference between land value before and after poln. *City Employees Exceed Authority.* (Galluzzi *v.* City of Beverly; 34 N.E. (2nd) 493 (May '41)) No employer responsible for acts of employee exceeding authority, or acting outside usual scope thereof, without knowledge or consent of employer. If employer or employee's superiors know employee exceeding usual authority, and permit same, then employer fully responsible. Applies to suits involving water poln. and all other injuries to private property. Fact that water pold. through negligence of employees not regularly employed in dept. effecting damage, does not relieve city.—*Ralph E. Noble.*

The Water Pollution Abatement Problems of the Petroleum Industry. R. F. Weston and W. B. Hart. W.W. & Sew. **88:** 208 (May '41). Article describes generally sources and characteristics of ordinary wastes arising from production and refining of petroleum and marketing of refined products. Authors emphasize that all wastes do not necessarily present major poln.-abatement problems. Major water poln.-abatement problems confronting petroleum industry enumerated as follows: (1) In production div., adequate disposal of brine produced with oil and oil wastes. (2) In refining div., reclamation of oil from emulsions and chems. from treating solns.; adequate disposal of wastes having high oxygen consuming characteristics, persistent taste and odor producing characteristics, and toxic effects on aquatic life. (3) In marketing div., adequate disposal of waste oils. About half article devoted to refinery waste problems. Much information included in 5 figs. and 3 tables. 52-reference bibliography.—*P.H.E.A.*

Biological Treatment of Sulfate-Mill Waste. C. L. Davis Jr. Louisiana Conserv. Rev. (Summer, '41) p. 36. Pulp-mill, bleach-plant and paper-mill wastes from Southern Kraft, Springhill, La., plant combine in impounding basin for controlled release into Bodcau Bayou. Sedimentation and action of lime and bleach wastes reduce 5-day B.O.D. of fresh mill waste from approx. 730 to 375 ppm.; suspended matter, carbonates, fibers and resinous fat acids settle out. During detention, B.O.D. further reduced as low as 65 ppm. by bacteria and rain diln. Evapn. and seepage cause 30–50% loss in vol. After initial exptl. filter abandoned because of sludging and lack of control, Dorr exptl. biofilter unit reduced B.O.D. of impounded wastes approx. 30%. D.O. rose on passage through filter from 2.6 to 2.9 ppm.; B.O.D. removal rate was 2.1 lb. per cu. yd. per day. Slime film stable and sludge in effluent negligible. B.O.D. reductions thought restricted by N insufficiency.—*C.A.*

War Production Board

Preference Rating Order P-46 Amended to March 26, 1942

ADMINISTRATIVE LETTER NO. 1

ON THE 26th day of March, 1942, the War Production Board issued Preference Rating Order P-46 amended, which will continue in effect until June 30, 1942, unless sooner revoked. This amendment [see p. 661, April 1942 JOURNAL] constitutes a complete revision of Order P-46 as originally issued on September 17, 1941, and of all amendments which have since been issued. The purpose of P-46 is to assist utilities in obtaining the minimum amount of materials necessary for maintenance, repair and operation. Public utilities are large users of material most vitally needed for armament. Every effort should, therefore, be made to effect the greatest economy in use of materials, and to undertake only those maintenance and repair jobs which are absolutely essential in maintaining minimum service standards.

A. The Order as amended effects a number of major changes, briefly outlined as follows:

1. The blanket rating of A-10 for maintenance, repair and operating supplies, has been changed to assign

(a) A-2 to deliveries of material for maintenance repair and operating supplies for production and pumping plant facilities; and

(b) A-5 to deliveries of material for maintenance, repair and operating supplies for all other facilities.

2. The Order also assigns an A-5 rating to deliveries of material for the construction of facilities necessary to serve new projects (other than housing projects) bearing a rating of A-5 or better, and an A-5 rating to deliveries of material needed for protection against sabotage, where such protection has been ordered by a Federal or State agency. These ratings, however, may not be applied until the utility has submitted the proposed construction for approval to the War Production Board, and has received notification from the Director of Industry Operations whether and to what extent the application has been approved. This procedure is designed to speed up the issuance of ratings for such construction. Applications to extend service to housing projects or to projects rated lower than A-5

must be made by the utility in regular form as a project application or on form PD-1A.

3. The restrictions on deliveries, withdrawals and inventory set forth in paragraph (f) have been clarified and further modified to give to producers relief from situations which are beyond their control. Paragraph (f)(1) previously placed a restriction on the acceptance of deliveries in a calendar quarterly period. Under the Order as amended the restriction is placed not on acceptance of deliveries but on the scheduling of material to be delivered in any calendar or quarterly period. This modification was made because utilities have no control over delays in delivery of material.

4. Paragraph (f)(3)(ii)(b) has been amended by prohibiting withdrawals for extensions of lines in excess of 250 ft. for the connection of new consumers.

If prior to March 26, 1942, a utility has commenced actual physical construction of a line or lines of more than 250 ft. in length relying on the 1,000-ft. limitation in the Order as previously drawn, such construction may be completed. No construction in excess of 250 ft. may be undertaken after March 26 without specific approval of the Director of Industry Operations. The distance between the point of connection to existing facilities and the consumers' service entrance (including the length of all intermediate service connections) should be considered in determining whether a particular extension comes within the 250-ft. limit. This change is made necessary by the very heavy demands which war production has placed on the supply of copper and other material.

5. Paragraph (f)(4)(iv) has been amended so as to enable utilities to obtain deliveries of short items of material within a class when the dollar value of the class exceeds a practicable working minimum inventory. This approval is limited, however, to deliveries which do not exceed 5 per cent of the dollar volume of withdrawals of material of the same class in the calendar year 1940. This changes both the amount and basis of measurement of the excess allowance previously authorized.

The foregoing summary of the changes effected by P-46 Amended is not intended to be complete. As the Order is mandatory on all Producers, you should study the Order carefully and take all necessary steps to see that your operations conform to its provisions.

B. As heretofore, the Director of Industry Operations may approve the scheduling and acceptance of deliveries and the withdrawal of material in excess of the restrictions contained in paragraph (f) if a Producer makes application therefor. A definite procedure for obtaining such approval has been established as follows:

1. Material for Maintenance, Repair and Operating Supplies.

(a) Whenever, in order to maintain minimum operating standards, it is necessary to acquire material or use material already on hand for maintenance, repair and operating supplies as defined in the Order and such acquisition or use would exceed the restrictions in Paragraph (f), the Producer should make application *by letter* setting forth the reasons why it is necessary to exceed the restrictions.

(b) Whenever material is required for maintenance, repair and operating supplies and such material cannot be obtained on the ratings assigned in the Order, application for a rating may be made on Form PD-1A. However, the material to which any rating is so assigned is subject to the inventory restrictions contained in Paragraph (f) of the Order. It is essential that no application be filed on Form PD-1A for material which is entitled to rating under P-46 until all practical possibilities have been explored for obtaining the material on the ratings provided under P-46.

2. Material for Additions to or Expansions of Property and Equipment. Except where authorized by the Order, no additions to or expansions of property or equipment will be authorized unless required for military needs, war production, or public health or safety.

(a) In such cases, if materials are on hand in excess of a practicable working minimum inventory or can be acquired without the use of a preference rating, application for approval to withdraw such materials may be made by letter setting forth the following information:

(i) Name of the operating company or agency.

(ii) Location of the proposed addition or improvement.

(iii) A clear, short statement of the scope of the work intended.

(iv) A comprehensive statement of the functional purpose of the work.

(v) A statement as to the relation of the work to military needs, War Production or public health or safety.

(vi) A schedule of the larger elements entering into the work and a statement of the total dollars value of materials and equipment to be withdrawn from inventory not to be replaced.

(b) If materials are not on hand and require a preference rating to obtain their delivery, application should be made on Form PD-1A or on a "Project" Form. Where a PD-1A Certificate is issued it shall constitute authority to use only the specific materials set forth in the application and shall not constitute authority to construct an entire job or project if the total quantity of material for the job or project is not specified in the application. The issuance of a Project Rating, however, shall constitute authority to use whatever material is necessary to

construct the entire project covered in the application up to the dollar value authorized.

(c) If some of the materials are on hand and other materials must be purchased by using a preference rating, application should be made on Form PD-1A or on a "Project Form setting forth in the application the information specified in Paragraph (a) above and also the quantity of material on hand and the quantity for which a preference rating is required.

(d) Approvals of applications made in accordance with paragraphs (a) and (c) above, will not authorize replacement of material taken from inventory.

Any communication with reference to P-46 as amended should be addressed to War Production Board, Washington, D. C. Ref: P-46.

(signed)
J. A. Krug
Chief, Power Branch

ADMINISTRATIVE LETTER NO. 2

Under Order P-46 as amended on March 26, 1942, no extensions in excess of 250 ft. can be made without authorization in advance from the Director of Industry Operations. A utility may, however, apply for permission to exceed this limitation. The policy which is being followed in passing upon applications is to authorize no extensions beyond the 250-ft. limit, except:

(a) Extensions to serve military or naval establishments

(b) Extensions to serve war production plants (only in unusual cases will consideration be given to duplicate supply lines and spare equipment in (a) and (b))

(c) Services required for public health and safety

(d) Extensions to serve war housing projects, where the use of critical materials in utility extensions has been kept to a minimum by proper planning

(e) Street lighting extensions which bear direct relationship to public health and safety in connection with military establishments or war production plants

(f) Extensions of service to homes which were wired or piped ready to receive service prior to March 26, 1942, or in the case of new houses, where the foundation of the house was completed before this date, provided that: (1) in the case of electric lines the extensions do not exceed

2,000 ft. of two conductor circuit per customer (No. 6 BWG) and galvanized steel wire is used in the construction; and (2) in the case of gas or water lines the extensions do not exceed 1,000 ft. of 2-in. steel or iron pipe or equivalent weight.

In determining the length of the extensions which are included under Order P-46, the measurement of the new construction should be taken from the point of connection to present facilities up to the service entrance to the consumers building. The service drop or service pipe is included within the 250-ft. limit. In electric installation where wires are carried on existing poles, this distance is included in the 250-ft. limit. The 250-ft. limit also applies to additions of third phase conductor.

Under Order P-46 utilities shall connect only facilities whose total length does not exceed 250 ft., measured as above, *including* any portion built by or for the consumer.

In suggesting the use of galvanized steel wire in extensions to wired houses within 2,000 ft., it should be pointed out that the use of steel wire for such extensions is a temporary expedient only, which is made necessary because of the war requirements for copper. It is recognized that customers served in this manner may not receive the most satisfactory class of service, but this is the only available means of providing electricity for these customers. Use of copper drop wire is permitted where steel wire primaries are used, but the length of drop wires should be reduced to a minimum. Conservation of materials during the war is the prime consideration, rather than the dollar cost.

This policy does not mean that we look with favor on unlimited extension of electric service by the use of steel wire, since this would put an undue drain on supplies of steel. The use of the relatively small quantities of steel wire required for extensions falling within the limits specified above has been approved by the Steel Branch of the War Production Board, but any extention of this policy might result in the use of steel in quantities which would interfere with the war effort.

It should be emphasized that extensions under the policy announced above are not automatically approved, and that authorization by the War Production Board must be obtained for each extension in excess of 250 ft. (see Administrative Letter No. 1, above, for procedure to be followed in obtaining approval).

The above policies are temporary and may have to be changed as circumstances require.

(signed)
J. A. Krug
Chief, Power Branch

Emergency Repairs

WHENEVER a need for emergency repairs of water works property or equipment arises from "acts of the public enemy, sabotage, explosion, fire, flood or other climatic conditions," or from accidental causes beyond the control of the water works operators and of such character that the need could not be foreseen, an application for an emergency rating may be filed in order to obtain prompt delivery.

The War Production Board defines an "emergency" as "actual breakdown or a situation where it is evident that a breakdown or suspension of operations is imminent because of damage, wear and tear, destruction, or failure of parts or the like, and the required parts or supplies are needed to repair machinery or equipment in order to avert such suspension or breakdown." Expected replacement of parts because of normal wear and tear, for which normal inventory can be maintained, is not included.

Emergency applications should not be filed in order to obtain material or equipment related to minor services or a service area where temporary adjustments can be made that will provide reasonably adequate water supply until repairs can be made in accordance with normal procedure.

Requests for emergency ratings should be in the form of a telegram addressed to:

Power Branch
Emergency Maintenance and Repair Section
Bureau of Priorities
War Production Board
Washington, D.C.

The request must give the following information:

1. Time, cause and extent of breakdown
2. Materials involved
3. Degree of emergency
4. Defense load involved if any
5. Name and address of supplier
6. Purchase order number and cost
7. Lowest rating with which material can be obtained on time
8. Priority order (order number and serial number) under which you are operating, if any.

The telephone may be used instead of telegraph (Republic 7500, Extension 5774), but it lacks the definiteness that can be recorded in a telegram. A letter is not a useful substitute for a telegram since its use is not indicative of emergency. If you decide to use the telephone, you

should have a memorandum in hand listing the information set forth above so that you will be prepared to answer all questions without hesitation.

After the request has been placed with the Emergency Section you should expect to receive a Form PD-333 for signature. The content of that form is shown below. You should be prepared, when you make the emergency application, to certify to the statements contained in Form PD-333. This form does not originate with the applicant. It originates in the Power Branch and is sent to the applicant for signature and return to Washington.

If state or regional mutual aid agencies exist, they are acceptable agents for filing requests for emergency ratings. (Refer to the JOURNAL for March 1942, page 473).—HARRY E. JORDAN, *Secretary, A.W.W.A.*

(Size of original form—8½" x 11"—1 page)

PD-333
3/3/42

CONFIRMATION — REQUEST FOR EMERGENCY ASSISTANCE — .... (Case #)

BUREAU OF PRIORITIES

SIGN AND RETURN TO .... — MAINTENANCE AND REPAIR BRANCH — Date ....

....
(Name of Company)

....
(Address) (City) (State)

Address of Receiving Plant ....
Description and quantity of Material Requested...
....
....
Supplier's statement: Delivery promised on .... with rating of ....
Purchase Order Number .... Value ....
Name of Supplier .... Address ....
Description of Product ....
Relationship to War Program, Public Safety or Health ....
....
Is Applicant operating under any Priority Order? ....
(Yes or No)
If so, state Order Number .... Serial Number ....
and reason for this Application ....
....
Concise statement of Emergency situation:
Request taken by ....

The undersigned hereby certifies to the Director of Industry Operations that: (1) The facts stated above are, to the best of his knowledge and belief, true and correct; (2) The quantity of material for which the preference rating is requested is the bare minimum necessity to effectuate the emergency repair; (3) The materials obtained with the assistance of the rating will be used only for the purpose of effectuating the emergency repair; (4) He executes the foregoing confirmation on behalf of and by authority of the above named applicant.

....
Signature and Title of Official — Date

Section 35A of the U. S. Criminal Code, (18 U. S. C. A. 80), makes it a criminal offense to make a false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

DEFINITION: "Emergency" means an actual breakdown or a situation where it is evident that a breakdown or suspension of operations is imminent because of damage, wear and tear, destruction, or failure of parts or the like, and the required parts or supplies are needed to repair machinery or equipment in order to avert such suspension or breakdown. Expected replacement of parts because of normal wear and tear, for which normal inventory can be maintained, is not included.

Procurement of Copper and Alloy-Steel Materials

CONDITIONS of utmost seriousness, resulting from recent war production board rulings (M-9-a and M-21-a) are now affecting the entire public water supply industry. Deliveries of copper-bearing, and many alloy-steel-bearing materials are restricted by these rulings to orders carrying a rating of A-1-k or better. This means that the preference ratings of A-2 or A-5 for maintenance and repair under order P-46 are of no practical value in obtaining anything which includes copper or certain grades of alloy steel. The only recourse at the moment lies in the filing of a PD-1A application for a rating of A-1-k or better for any unit of material or piece of equipment (required for construction, maintenance or repair of public water supply works) which contains copper or certain alloy steels.

The WPB Alloy Steel Unit has ruled that orders for water works maintenance and repair materials affected by WPB Order M-21 are to be classed under the "All Other" heading. Any order for steel- or iron-bearing products for water works must now be endorsed as follows:

> The undersigned certifies to the Producer and to the War Production Board that the material ordered herein is to fill orders in Group Classification ["*All Other*"]
>
> *Name of Purchaser*
>
> *Authorized Official*
>
> *Title*

Public water supply executives must maintain balanced thinking and co-operate in the war effort by accepting its need for every possible bit of metal. At the same time, we must realize that military production depends upon successful industry operation and industry operation in turn depends upon adequate water supply and the maintenance of public health and safety. Public water supply structures must therefore be maintained to support military production. Consequently any reasonable representations concerning the need of municipal water works appear to be perfectly proper. In a statement dated May 22 concerning the rubber situation, WPB Chief Donald M. Nelson, said it affected the civilian population more than anything else but food and *water*.

Naturally, constructive advice is also requested. We are facing a serious situation which calls for the co-operation of everyone who has an interest in the American people's safety and health as they are affected by the public water supply service.—HARRY E. JORDAN, *Secretary, A.W.W.A.*

End Use Allocation

WAR PRODUCTION officials understand that the present practically complete suspension of deliveries of such materials as copper and steel to essential civilian uses cannot continue long. Things are moving definitely toward an *End Use Allocation* of all critical metals. The procedure may become effective as of July 1, 1942.

To obtain standardization, to reduce the number of differing forms, and to furnish information needed by the War Production Board in the allocation of materials, a series of End Use Classification numbers or symbols has been set up, as shown below. *The symbol numbers have no relation to order of importance.*

Military

Class 1.00—Aircraft—Production and Maintenance (complete except for armament and ammunition).

Class 2.00—Ships—Production and Maintenance (complete except for armament and ammunition).

Class 3.00—Vehicles—Production and Maintenance (complete except for armament and ammunition).

Class 4.00—Armament and Weapons—Production and Maintenance (complete with mounts and related equipment).

Class 5.00—Ammunition—Production and Maintenance (complete items).

Class 6.00—War Equipment and Supplies—Production and Maintenance (complete with related equipment).

Class 7.00—War Facilities—Construction and/or Maintenance.

Industrial and Civilian

Class 8.00—Raw Materials—Production and Processing.

Class 9.00—Power, Light and Heat.

Class 10.00—Transportation.

Class 11.00—Communication.

Class 12.00—Public Health and Safety.

Class 13.00—Agricultural Equipment and Supplies.

Class 14.00—Industrial Food Processing.

Class 15.00—Textiles and Wearing Apparel.

Class 16.00—Equipment and Supplies for Household Use.

Class 17.00—Education and Recreation.

Class 18.00—Equipment and Supplies for Office Use.

Class 19.00—Machinery and Equipment for Industrial Use.

Class 20.00—New Buildings, Construction of.

Class 21.00—Operating Supplies and Building Repair and Maintenance.

Class 22.00—All Other End Uses—(excludes all sub-assemblies and parts going into finished products coming within the other classes).

The specific instructions which relate to water supply operations, at present, are as follows:

Class 12.00—Public Health and Safety

12.10—Sanitary Systems and Facilities: This End Use Symbol should be placed on all orders for materials, equipment, supplies, etc., for water systems, sewage systems, garbage disposal plants, etc.

Construction of new buildings and building maintenance and repair should not be included in this classification (see Classes 20.00 and 21.00).

Class 20.00—New Buildings (Construction of)

The prime contractor has the responsibility for placing these End Use Symbols on all purchase orders he issues for materials and equipment for the construction of all types of civilian and industrial buildings. These classification numbers should be placed on orders for all items which are actually incorporated into the building itself, i.e., such things as elevators, escalators, plumbing and heating systems, wiring, incinerators, and air-conditioning systems are included only so long as they are actually attached to and form part of the building. Portable air-conditioning units, industrial machinery, refrigerators, stoves, and other similar items should not be included under this symbol. Orders for materials for the construction of government-owned war facilities should be assigned Class 7.00 symbol.

20.10—Buildings for Manufacturing and Commerical Purposes, Construction of: This End Use Symbol should be placed by the prime contractor on all orders for materials, equipment, etc., for buildings such as:

All types of buildings for industrial plants including assembly and warehouse buildings
All types of railroad buildings
Buildings for electric generating plants
Hangars, commercial and private and other commercial airport buildings
Mine buildings
Office buildings
Stores
Telephone control offices and repeater stations
Etc.

HARRY E. JORDAN, *Secretary, A.W.W.A.*

Water Storage for Air Raid Defense

THE Office of Civilian Defense on April 26, 1942 asked civilians not to wait until an air raid warning actually sounds before providing water storage for emergency needs. A statement by Dr. George Baehr, Chief Medical Officer, outlined water storage procedure as worked out with other interested agencies including fire insurance companies. Dr. Baehr stressed these points:

(1) If thousands of bathtubs, sinks and other receptacles are filled simultaneously, municipal water pressures will be dangerously lessened.

(2) Water from fire hydrants and house taps will not be available for emergency fire fighting.

Every effort is being made to warn householders, business houses, apartments and industrial plants not to wait until an air raid is imminent to provide water storage for emergency needs.

Co-operating with the National Board of Fire Underwriters, the American Water Works Association, and the U.S. Public Health Service, OCD is recommending this procedure for water storage for emergency purposes:

(1) Keep several receptacles, of two types, filled with water at all times. Water stored for drinking and household reserve should be kept in covered receptacles to prevent impurities. Water stored as a reserve for fighting fires need not be covered and should be kept in easily accessible places, preferably one on each floor.

(2) Do not wait until the air raid alarm is sounded to fill receptacles. The sudden drain on the water supply, if thousands of householders turn on water at the same time, may dangerously deplete the municipal water pressure and cut off the flow of water needed by local Fire Departments and their Citizens Defense Corps auxiliaries.

(3) If an air raid occurs, water mains may be broken and certain sections deprived of water for a short period of time. For a period of 24 hours following the restoration of water service, all drinking water from the tap should be boiled briskly for a minimum of five minutes, unless otherwise instructed by the health department. The peculiar flat taste of boiled water may be partially removed by pouring the cooled water back and forth several times between two clean receptacles and by adding a pinch of salt.

(4) During the summer, water standing in open receptacles—for use in putting out fires—may furnish breeding places for mosquito larvae (wiggletails). One teaspoonful of kerosene or fuel oil sprinkled on the surface of the water once each week will prevent mosquito breeding. This oil evaporates in a few hours and therefore does not constitute a fire menace.

Selective Service Memorandum

Re: Occupational Classification

Part I—Responsibility for Occupational Classification

1. The Selective Service System has the responsibility to select men for military service and to furnish them at the time and in the number necessary for the armed forces of the Nation. On the other hand, thi Selective Service System has the corollary responsibility to select for retention in their civilian endeavor an adequate supply of trained, qualified, or skilled men in order to maintain those civilian activities necessary to war production and other civilian activities essential to the support of the war effort.

2. It is therefore the responsibility of the Selective Service System to allocate the manpower of the Nation among the armed forces, civilian activities necessary to war production, and other civilian activities essential to the support of the war effort.

3. The manpower resources of this country, when properly allocated, will supply the requirements of the armed forces, war production, and other essential activities supporting the war effort. Geographical and employment dislocations of trained, qualified, or skilled personnel exist and must be recognized and properly taken into consideration to prevent a wastage of such manpower.

4. Thus the Selective Service System, through the process of classification, must do its part to accomplish an orderly adjustment of the manpower resources of the Nation, so that all available men will properly and expeditiously be directed into that channel of activity where the Nation at war will be best served.

Part II—Occupational Classification Policy

1. In defining our present policy on the occupational classification of registrants, attention is called to the fact that no substantial change has been made in the Act or Regulations.

This Memorandum to All State Directors (I-405), Local Board Release (115) was issued on March 16, 1942, effective immediately. A record of A.W.W.A. activity in this field will be found on page 1 of the News of the Field section of this issue of the JOURNAL.

2. When Selective Service began, late in 1940, our Nation was at peace. With the advent of war on December 8, 1941, the requirements of the armed forces and the demands for war production were drastically increased. Men and materials are being drawn from the non-essential activities and being directed in increasing numbers and amounts to the use of the armed forces, to war production, and to other activities supporting the war effort.

3. Many of the benefits, conveniences, and comforts which the people of this Nation have enjoyed in peacetime must necessarily be given up in the national interest. Now only those civilian activities which are really necessary to war production or essential to the support of the war effort can be accorded the protection of occupational deferment from military service in the armed forces. In order to allocate manpower and to be assured that the activities essential to the prosecution of the war are properly developed and maintained, a new interpretation must now be placed on the phrases "national health, safety, or interest," and "war production."

4. In the determination of who shall and who shall not be deferred by reason of his occupation in civilian activity, the Selective Service System must consider occupational classification in accordance with this new interpretation. This new interpretation will require a more careful consideration of the essential character of the activity in which the registrant is engaged, the occupation which the registrant holds in that activity, and the need for the registrant in that occupation.

Part III—Civilian Activities Supporting the War Effort

1. Selective Service Regulations provide that in Class II-A shall be placed any registrant who is found to be a "necessary man" in industry, business, employment, agricultural pursuit, governmental service, or any other service or endeavor, the maintenance of which is essential to the national health, safety, or interest.

2. Now that we are at war the phrase "national health, safety, or interest" no longer includes mere convenience and comfort. Activities essential to the national health, safety, or interest are now limited to those activities, other than war production, which support the war effort. Activities supporting the war effort include those activities which provide food, clothing, shelter, health, safety, and other requisites of our daily life.

3. In order that an activity may be considered essential to the support of the war effort, its facilities must be predominantly devoted to that purpose.

Part IV—Civilian Activities Necessary to War Production

1. Selective Service Regulations provide that in Class II-B shall be placed any registrant found to be a "necessary man" in any industry, business, employment, agricultural pursuit, governmental service, or other service or endeavor, the maintenance of which is necessary to the war production program.

2. With reference to such civilian activities, the phrase "necessary to the war production program" now means the work of processing or producing ships, planes, tanks, guns, and other machines, instruments, articles, and materials directly used in the prosecution of the war.

3. In order that an activity may be considered as necessary to war production, its facilities must be predominantly devoted to that purpose.

Part V—Critical Occupation

1. In order that a registrant may be considered as a "necessary man" in an activity necessary to war production, or in any other activity essential to the support of the war effort, such registrant must be engaged in a "critical occupation."

2. A "critical occupation" in any such activity is one which must be filled by a man with the required degree of training, qualification, or skill for the proper performance of the duties involved. Occupations in order to be considered "critical occupations" must be such that, unless they are filled by men with the required degree of training, qualification, or skill, there will be a serious loss in the effectiveness of the activity.

3. "Critical occupations" exist only in activities which are necessary to war production or are essential to the support of the war effort. If the activity is neither necessary to war production nor essential to the support of the war effort, then no occupation within that activity can be considered as a "critical occupation" and, in such case, there are provided no grounds for occupational classification.

4. Not all occupations within activities necessary to war production or essential to the support of the war effort are "critical occupations." When an occupation within an activity necessary to war production or essential to the support of the war effort is not itself a "critical occupation," then, in such case, there are provided no grounds for occupational classification.

Part VI—Necessary Man

1. Selective Service Regulations provide that a registrant shall be considered as a "necessary man" in an activity necessary to war production or an activity essential to the support of the war effort only when all of the following conditions exist:

(a) He is, or but for a seasonal or temporary interruption would be, engaged in such activity;

(b) he cannot be replaced because of a shortage of persons with his qualifications or skill in such activity; and

(c) his removal would cause a serious loss of effectiveness in such activity.

2. In order to warrant occupational classification as a "necessary man" a registrant must be engaged in one of those activities which have been certified by the Director of Selective Service to be, and which the agencies of the Selective Service System consider to be, actually necessary to war production or essential to the support of the war effort, provided, however, in the absence of certification, the agencies of the Selective Service System will consider the necessary or essential character of such activities without the assistance of such certification.

3. Such registrant must be engaged, or but for a seasonal or temporary interruption would be engaged, in such activity. By seasonal or temporary interruption is meant not a voluntary interruption of the work, but rather an interruption beyond the registrant's control and of such a character that he is willing to resume and will resume work in such activity at the earliest time when he is needed.

4. There must be a shortage of available men with the required training, qualification, or skill, in such a manner that, if the registrant were removed from his "critical occupation," he could not be replaced, and, if he were removed from such activity and his occupation left vacant, his removal would cause a serious loss of effectiveness in such activity.

Part VII—Shortages of Trained, Qualified or Skilled Men

1. It will be observed that one of the important tests for the determination of who is or who is not a "necessary man" is whether there is a shortage of men with the required training, qualification, or skill, to the extent that, if the person engaged in the "critical occupation" were removed from his occupation, he could not be replaced.

2. In the application of this test it will be found that shortages exist in varying degrees with respect to individuals in "critical occupations." Persons in "critical occupations" where there is required a great amount of training, qualification, or skill will normally be more difficult to replace than persons in occupations where only a small amount of training, qualification, or skill is required.

3. The training of persons for "critical occupations" in activities necessary to war production and in other activities essential to the support of the war effort will be undertaken and maintained in such a manner that, as much as possible, existing shortages will be relieved, contemplated

shortages will be prevented, replacements will be provided for men now occupationally classified, and replacements will be provided in sufficient time to prevent the necessity of occupational deferments in the future.

4. When, in any activity which is either necessary to war production or essential to the support of the war effort, a man who is to be inducted into military service is replaced, effort should be made to replace such man with another person who, by reason of dependency, physical condition, or sex, will not be expected to be inducted into military service. To do otherwise will be merely to create another occupational classification problem and the question of replacement will again arise at a later date.

5. The same principle applies with respect to those activities which are expanding their facilities and accelerating their production. Consistent with the maximum of expansion and acceleration, the new personnel required for the added facilities and the increased effort should be drawn from those persons who by reason of dependency, physical condition, or sex, are not expected to be inducted into military service.

6. In order to accomplish a proper and efficient allocation of manpower those persons who are expected to be inducted into military service should be reserved for the armed forces of the Nation, and those activities which are necessary to war production or essential to the support of the war effort should be maintained, as much as possible, by personnel which is not expected to be inducted into military service. This will be accomplished only by an expeditious and orderly application of the policy of occupational classifications and by a practicable program by such activities of employment, training and replacement.

7. In no event shall men who are expected to be inducted into military service in the future be discriminated against in employment. All activities are expected to employ such men in non-critical occupations or in critical occupations where they may be readily replaced without the future necessity for their occupational deferment.

Part VIII—Necessary Man in Training and Preparation

1. Selective Service Regulations provide for the occupational classification of a registrant who is found to be a "necessary man" in "training and preparation" for any industry, business, employment, agricultural pursuit, governmental service, or other service or endeavor, the maintenance of which is necessary to war production or the maintenance of which is essential to the support of the war effort.

2. When a person is in training and preparation, other than in industry, it is usually impossible to determine whether he is training and preparing for an occupation in any particular activity. For this reason any person who is found to be a "necessary man" by reason of undergoing such train-

ing and preparation may be considered for classification only in Class II-A, and shall not be considered for classification in Class II-B.

3. In order for a person in training and preparation to be considered as a "necessary man," all of the following conditions must exist:

(a) He must be in training to acquire a qualification or skill which fits him for a "critical occupation" in an activity necessary to war production or essential to the support of the war effort;

(b) there must be an existing or contemplated shortage of persons, in activities necessary to war production or essential to the support of the war effort, who possess the training, qualification, or skill which the registrant is in training and preparation to acquire;

(c) there must be a shortage of persons who are undertaking such training and preparation to the extent that even though all such persons successfully complete the training and preparation and enter "critical occupations" in activities necessary to war production or essential to the support of the war effort, the shortage existing in those activities will not be entirely relieved; and,

(d) he must have advanced sufficiently in his training and preparation that there is a reasonable basis for assuming that he gives promise of the successful completion of the training and preparation, of attaining the desired training, qualification, or skill, and of becoming a "necessary man" in an activity necessary to war production or essential to the support of the war effort.

4. If a registrant is in training and preparation in a recognized and accredited academic, professional or technical college or university, it must be concluded that he will not have sufficiently demonstrated his ability to the extent that he gives promise of successfully completing such training and preparation, until approximately the satisfactory completion of the second academic year of his college work. It therefore appears reasonable that no registrant should be given an occupational classification as a "necessary man" in training and preparation until the close or approximately the close of the second academic year of his college work, and then only if he has been accepted and enrolled for advanced training and preparation by a recognized and accredited college or university. In any event, such registrant at the close or approximately at the close of his second academic year and subsequently, must meet and must continue to meet the tests for a "necessary man" in training and preparation for a "critical occupation" in an activity necessary to war production or essential to the support of the war effort.

5. If the registrant is in training and preparation in a recognized trade or vocational school which offers a short course of training and preparation, it is not reasonable that such registrant should be accorded an occupational

classification unless he is definitely acquiring training, qualification, or skill for a "critical occupation" in an activity necessary to war production, and then only if there is an acute shortage of persons with that training, qualification, or skill in the activity and, in addition, there is an acute shortage of persons taking or available to take such trade or vocational training and preparation.

6. Apprentices, trainers, and learners are not considered as in training and preparation, but are considered as engaged in an occupation within an activity, and will be considered for occupational classification in the same manner as any other registrant engaged in an occupation within an activity.

Part IX—Occupational Bulletins

1. Using this memorandum as a basis, the Director of Selective Service will, from time to time, issue Occupational Bulletins which will provide information as follows:

(a) That the particular civilian activity is considered essential to the support of the war effort under Part III of this memorandum, or necessary to war production under Part IV of this memorandum;

(b) a list of the "critical occupations" within such activities which require a degree of training, qualification, or skill, and the removal of persons from which will cause a serious loss of effectiveness in such activity under Part V of this memorandum;

(c) the known supply of persons with the training, qualification, or skill required to engage in such "critical occupations," including particularly information with respect to shortages of such persons and the amount of training needed to secure the required qualification or skill, under Part VII of this memorandum; and,

(d) the known supply of persons in training and preparation, when such question is involved, and a list of recognized trade or vocational schools, where such question is involved, under Part VIII of this memorandum.

2. Information forwarded to the agencies of the Selective Service System from time to time in the form of Occupational Bulletins will have been received by the Director of Selective Service from sources which are considered reliable. Such information will be obtained as a result of study and investigation, and may be considered as the best information available upon the subject.

3. When the data contained in Occupational Bulletins is received by the agencies of the Selective Service System it will be given full weight and consideration in the determination of occupational classifications.

4. Whenever the agencies of the Selective Service System have in their possession information which convinces them that the data contained in

the Occupational Bulletins does not apply in the case of occupational classifications, such agencies shall so advise the Director of Selective Service, through the State Director of Selective Service, giving their reasons and the information upon which they consider that the Occupational Bulletin information does not apply. Whenever any State Director of Selective Service receives from any agencies of the Selective Service System, or from other sources, information indicating that the Occupational Bulletin data does not apply he shall notify the Director of Selective Service, providing him with such information.

5. The forwarding of Occupational Bulletins is a part of a program to provide the agencies of the Selective Service System with information concerning those activitities necessary to war production and essential to the support of the war effort, those occupations within such activities which are considered "critical," and the known supply of trained, qualified, or skilled persons to fill such occupations. This information will be forwarded as rapidly as it is available, with the ultimate purpose that all necessary information with respect to activities, occupations, and the supply of trained, qualified, or skilled persons will be furnished to the agencies of the Selective Service System.

6. It must be realized that this information covering all subjects cannot be compiled for publication in Occupational Bulletins at one time. As rapidly as possible the information on various activities will be made available. Until such information is available in the form of Occupational Bulletins, the agencies of the Selective Service System should proceed with occupational classifications in accordance with the policy as expressed in this memorandum and upon the information which has previously been forwarded to or may from other sources become available to the agencies of the Selective Service System. The various Memorandums to All State Directors and Local Board Releases heretofore issued with regard to occupational classifications will remain in full force and effect until specifically superseded.

7. The agencies of the Selective Service System should not conclude from the fact that an Occupational Bulletin has not been issued with respect to a certain activity that such activity is not necessary to war production or essential to the support of the war effort. In such case it may be that the information has not yet been received by the Director of Selective Service. When in the consideration of occupational classification the agencies of the Selective Service System have not received from the Director of Selective Service an Occupational Bulletin with respect to the activity concerned, full consideration should, nevertheless, be given to the activity under Part III and Part IV of this memorandum; to the particular occupation of the individual under Part V of this memorandum;

to the supply of persons with the required training, qualification, or skill under Part VII of this memorandum; and to the status of the registrant as a "necessary man" under Part VI of this memorandum.

8. Information concerning activities, occupations, and shortages, as referred to in this memorandum will be issued from time to time as Occupational Bulletin No. 000. From time to time there also will be issued for use by the agencies of the Selective Service System, an index to all such bulletins, both by activity and by critical occupation.

(signed)
LEWIS B. HERSHEY,
Director

Maximum Standards for War Housing

J. A. Krug, Chief of the WPB Power Branch, on May 18, 1942, released a memorandum to water and gas utilities regarding extensions to War Housing Projects:

"Because of the critical need for raw materials for use in the war effort, it has been necessary to adopt drastic measures with respect to the use of these metals in extensions of utility service. . . . Certain standards have been developed to serve as criteria in passing upon such extensions. . . . The weight and distance allowances included in these standards are maximum allowances. . . . *The War Production Board requires that no new housing project be started prior to obtaining approval for extensions of utility services.*"

The size of mains laid in war housing areas will conform to reasonable fire protection needs. "Mains larger than 2 in. in diameter will be approved only in cement-asbestos unless the applicant can use iron or steel pipe *from stock without replacement.*" Three-inch cement-asbestos should be substituted for 2-in. iron or steel pipe when pipe must be purchased. Service lines will be approved in steel only—½ in. in diameter for single dwelling units and appropriate larger sizes for multiple units. A 50-ft. limit is set for individual service lines on housing started after April 22—60 ft. on housing started at a prior date.

[Questions have been raised concerning the purchase of ½-in. fittings for service lines. Advice has been given by the A.W.W.A. office to use larger sizes (if in stock) bushed down to suit the ½-in. service pipe. Substantial delay would be caused by withholding installation of service lines until small size fittings could be obtained.]

APPLICATION FOR MEMBERSHIP
IN THE
AMERICAN WATER WORKS ASSOCIATION
22 EAST 40th ST., NEW YORK

Date:..

.... hereby make application for
(I or We)

....
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of $............................, one year's dues in advance.

Name..

Company or Department...

Title or Position..

Address...

....

If application is for Junior Membership, give date of birth...........................

If application is for Affiliate, state number of active services in property where employed...

Nature of business or character of work (for office records)..........................

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If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

....
Signature of Applicant.

Application obtained by:

....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

News of the Field

The New Year calls for courage and co-operation and common sense. Courage is needed to meet the shocks that will come to American complacency. We have been a too-well-satisfied-with-ourselves people, too easy going and too much inclined to take our privileges for granted. So we need courage for the harder life that must be lived all the rest of the days that any of us now living will see—to the end that those who live after us will find this world a cleaner place for living.

We need a co-operative spirit—an understanding that the things we are handling ourselves, even public water supply,—are not to be maintained at the expense of others. Insofar as the service we render is important to the well-being of the community and the nation, just so far are we entitled to defend to the utmost the thing we do. But everything that has been going on in the careless days is not vital. The new suit or the new car or the new house or even that new water works pump—if we we do not get them today—will not keep the sun from rising.

There is always a tomorrow for a free and co-operative people. But that tomorrow is being saved for us by men who are giving up all their tomorrows. If we give up our today's unnecessary wants, too many of them will not have to give up their tomorrows.

And above all we need common sense, a sense of balance, an understanding that even water works men are not entitled to special privileges at the expense of the rest of the community. (Now grab your chair and count ten!) There are still water works men in the United States who feel that they should still be able to get anything they want at once with no forms to be filled out and no priorities to interfere. Common sense will tell anyone of us that the soldier in the Philippines and the sailor at sea have first call on the industrial resources of this country. Surely, public service such as water supply runs close after direct defense. But what do you really want—defense or defeat? Use your good American Common Sense!

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"Air Raid Warning System" is a publication prepared by the War Dept. and issued by the Office of Civilian Defense, Washington, D. C., under date of September 1941. Available from local organizations as well as from Washington, D. C., this booklet in five chapters covers the following: the general plan, the military aircraft warning service, the civilian air raid warning system, public warning systems, and training.

G. E. Arnold has been called to service as Regional Sanitary Engineer in Charge of Civilian Sanitation in the Ninth Corps Area which comprises nine western states. Mr. Arnold, who is on leave of absence from the San Francisco Water Dept., has had to deprive the California Section of his services as Secretary-Treasurer. The California Section has been most fortunate in having beginning January 1 the services as Secretary-Treasurer of H. Arthur Price, Specification Engr., Los Angeles Bureau of Water and Power.

Tobias Hochlerner has been made Chief Engineer of New York City's Dept. of Water Supply, Gas and Electricity, to fill the position left vacant by the death of William Flannery. Mr. Hochlerner previously served as Deputy Chief Engineer, a position to which Edward Nuebling has been appointed. Charles D. Livant, former assistant to Mr. Nuebling, replaces him.

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December 8, 1941
Havana, Cuba

Mr. Louis R. Howson, President
American Water Works Association
22 East 40th St.
New York, N. Y.

My dear Mr. Howson:

The treacherous attack of the Japanese upon your great country has shocked little Cuba and 100 per cent of its native population. As a member of the A.W.W.A. and a member of its Board of Directors, I wish to record my heartiest sympathy with my fellow members, citizens of the United States.

I am sure that our Chairman will write you further on behalf of the Cuban members expressing our desire to help in any way that we can as Cuba has already declared war on Japan.

Most sincerely yours

(signed)
ING. JOSE GARCIA MONTES

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Report of the Virginia Section Meeting

The Eighth Annual Meeting of the Virginia Section was held October 30 and 31 at the Hotel Roanoke, Roanoke, Va. The official registration was 153, which included 39 of the Section's 68 members, giving a Henshaw Cup percentage of 57.3.

The morning session on Thursday was devoted to registration and golf, the golf tournament being sponsored by the Section, with M. J. Seebert in charge. Seven prizes were given.

Chairman R. W. Fitzgerald called the afternoon session together, beginning with an address of welcome by Roanoke City Councilman W. B. Carter. R. C. Bardwell then gave a complete and interesting report on the Toronto Convention.

In a paper entitled "The James River Project of the Virginia Academy of Science," Marcellus H. Stow, Prof. of Geology at Washington and Lee University, outlined the 5-year, long-range planning project for the river basin. Since specific problems related to hydrology, water resources, flood control and stream pollution will arise in the process of this planning to improve the area as a human habitat, R. C. Bardwell made a motion, which was passed, assuring the assistance of the Virginia Section in the work.

Stuart Royer, Consulting Engineer of Richmond, described under "Water Supply for Chesterfield County" a study of the problem of supplying water to the rapidly developing areas in the eastern part of the county where 60 per cent of the county's population lives in 14 per cent of the area. The City of Richmond is not interested in undertaking to supply such a large amount to so extensive an area at a cost attractive to the consumers. Purchasing a dam and impounding lake, formerly owned by the Virginia Electric and Power Co. on Swift Creek, and building a new dam on Falling Creek will provide necessary storage and with the construction of a distribution system will cost $1,248,790 to serve a population of 25,000.

A. E. Griffin of the Wallace & Tiernan Co., Inc. gave an informative paper entitled "Super-Chlorination." Many points about break-point chlorination and the use of ammonia were clarified by Mr. Griffin's paper and in the ensuing discussion.

Under "Defense of Water Supplies for the Army and the General Public" Col. W. A. Hardenbergh, Sanitary Corps, Office of the Surgeon General, U. S. Army, gave assurances that studies of the Army Chemical Warfare Service indicated that treatment plants may readily nullify the effects of poisonous gases put in water supplies.

In the absence of E. F. Dugger, Manager, Newport News Water Works Com., due to defense activities, Reeves Newsom, Engineer-Con-

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1942 MEMBERSHIP PROMOTION AWARD

One of our Honorary Members—a Past-President of the A.W.W.A. who wishes to remain anonymous—has very generously provided the funds for a special award for 1942. It will be known as the "1942 Membership Promotion Award," and will be given to the two members (Active or Junior) of the Association who bring in the greatest number of new members during the calendar year 1942.

Why should the American Water Works Association expand its membership in 1942? Because the Association is giving essential service to water works men—because the benefits to members are greater than they have ever been before—because the ability of the A.W.W.A. to serve the interests of water works men increases as the membership increases—because no water works man can carry on his work as well outside the A.W.W.A. as he will be able to do if he is a member.

The prizes offered are:

First prize—One United States Defense Bond having a maturity value of $100.00.

Second prize—$25.00 in cash.

The first prize will be given to the Active or Junior Member who obtains the largest number of new members, and the second prize will be given to the one who obtains the second largest number of applications. In case of a tie, an equal division of the first and second prizes will be made. All active and Junior Members including Section officers are eligible to compete. General officers of the Association and members of the headquarters staff cannot compete.

Applications considered in the competition must be endorsed in the lower-left-hand corner with the name of the member who obtains the applicant's signature. Applications will be credited in the competition to the member who thus endorses this form. They will not be entered to the credit of the member obtaining them until dues for one year's membership have been paid by the applicant. This dues-payment can be made at the time the application is filed, or it can be paid after the Board has approved the application and a bill sent to the new member.

Computation of credit will be based upon the dues-accrual from new memberships. This is based upon the fact that the amount of energy and salesmanship required to obtain new members increases just as the dues payments increase. It is harder to get an Associate Member signature on the dotted line than to get an Active Member; harder to get a Corporate than an Affiliate. So the graduated scale of credits for new applications is set up. Active Memberships will count as 1 unit; Associate Memberships, 2.5 units; Corporate Memberships, 1.5 units; Junior Memberships, 0.5 units; Affiliates, 0.4 units. For example, a member who obtains applications from 1 Associate, 2 Corporate, and 3 Active Members will get 8.5 unit credits. A member who brings in applications from 2 Corporates, 2 Active Members, and 2 Affiliates will get 5.8 unit credits. The total of unit credits accruing to members who compete will be the basis of the awards.

The 1942 Membership Promotion Award thus gives the loyal and interested member opportunity to bring the values of the Association to new members, and, at the same time, to win a worth-while reward for his energy and salesmanship.

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sultant of New York, spoke on "The A. W. W. A. Committee on Defense." Mr. Newsom quoted and analyzed many rules and regulations on priorities and helped many superintendents by clearing up numerous questions.

Immediately following the annual dinner, the selection of D. R. Taylor, Plant Supt. at Roanoke, as the recipient of the Fuller Memorial Award was announced by Richard F. Wagner, Chairman of the Committee. For a half hour after the dinner and ceremonies, the audience was entertained with magic performed by H. Lloyd Nelson, Eastern Sales Mgr., U. S. Pipe and Fdry Co. After the showing of a techni-color movie on "Cast-Iron Pipe," the evening session adjourned.

The Friday morning session led off with an excellent paper by C. L. Crockett, Chief Chemist of the Norfolk & Western Railway,—"Ultra Violet Fluorescence in Laboratory Problems." For laboratory purposes, the same ultra violet ray as that used in fluorescent lights is confined in a tube around which is a glass tube impregnated with the necessary materials to filter out all visible rays, leaving only the ultra violet. Using the fluorescent microscope each species of bacteria has a characteristic fluorescent color. Mr. Crockett said it was not too much to predict that some

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day pathogenic and non-pathogenic organisms in drinking water would be differentiated by this method.

H. E. Lordley, Plant Manager, Filter Plant, Richmond, supplemented with blackboard sketches and figures his paper "Removal of Iron from Small Water Supplies." After a summary of numerous methods, Mr. Lordley told how at Richmond caustic soda and chlorine are added to the water as it is pumped from the well and the water is carried to the elevated tank through a pipe line extending up through the tank riser pipe and is discharged through a T-fitting. Water is pumped during periods when there is little or no demand on the system. The iron floc formed settles in the tank riser pipe and is blown off periodically.

Charles W. Davis, Supt., Water Dept., Petersburg, described his experience cleaning a 17,000-foot, 16-inch raw water main from the intake to the filtration plant. The line was cleaned by the National Water Main Cleaning Co. at a cost of seven cents per foot and was out of service only six hours. The coefficient C was 70 before cleaning and 125 after. A power saving of \$650 per month was effected, thus paying for the cleaning in considerably less than three months and making available an additional

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capacity of 3 m.g.d. needed to supply Camp Lee while a new 20-inch parallel raw water main was being constructed.

W. P. Kanto, Town Manager of Norton, outlined the history of that plant since it was purchased from a private company in 1926. A new dam and new storage tanks have been built; service lines have been lowered to prevent freezing; and adequate supply has been developed to hold through the present drought, which was not the case in 1939 when abandoned wells were used in the emergency. I. T. Jessee, Town Manager, Richlands, under the title "Steel Filter Plant Installation at Richlands," described the new plant with particular reference to the circular steel coagulation basin equipped with spiral baffle and built-in mixing basin of unique design.

J. B. Vance, Maintenance Manager, Washington County Sanitary Dist., Abingdon, Va., gave an original and humorous presentation—"Experience With Water Supply for Washington County Sanitary District." Numerous breaks during sub-zero weather and the washing out of five river crossings during a flood contributed only a part of the trials and tribulations of starting this system which is now a paying proposition and an asset to the county.

A. W. W. A. President Louis R. Howson gave a good account of the activities of the Association. Officers elected for the coming year were: Chairman, R. J. Leveque; Vice-Chairman, C. L. Crockett; Trustees, R. W. Fitzgerald and J. C. Hanes; Secretary, N. Phillips, Jr.; and Treasurer, E. C. Meredith. R. C. Bardwell, previously elected, continues as Director.

A paper on "Sterilization of Water Mains" by W. H. Shewbridge of the State Health Dept. was read, in the absence of Mr. Shewbridge, by H. B. Snyder, Jr., also of the State Health Dept. The author emphasized the importance of keeping mains clean during laying and described methods of using liquid chlorine, hypochlorite, and chlorinated lime. Richard F. Wagner said extensions at Lynchburg were sterilized by adding dry hypochlorite to the mains as laid. R. W. Fitzgerald described sterilization at Norfolk with a diffuser applying liquid chlorine. After a first sterilization in May 1940, a re-sterilizing was done every third to tenth day employing as much as 550 p.p.m. until September without obtaining satisfactory results. The line was then relaid using jute which had been sterilized by steam. The main was again sterilized and samples examined showed it free of contamination. R. C. Bardwell cited the use of 2 lb. of caustic soda in dry form added to each section of pipe, with satisfactory results. In response to a query by L. H. Enslow, Mr. Bardwell said no injury to the pipe lining had been noted with this method.

Chris F. Bingham, Dist. Sales Mgr., Columbia Chemical Div.,

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Pittsburgh Plate Glass Co., Philadelphia, gave much information under the title "How Chemical Manufacturers Can Render Service to Small Water Works." A. B. MacTaggart of Rusta Restor Corp., Fremont, Ohio, summarized the development and application of cathodic tank protection.

Richard Messer, Director of the Bureau of San. Eng., State Dept. Health, presided at a very active and enlightening question and answer period.

N. PHILLIPS, JR.
Secretary

Asheboro, N. C., is planning to extend its water works system and to construct a new dam and reservoir. W. E. Yow is Supt. of the Water Dept. and William M. Piatt, Cons. Engr. of Durham, N. C., will make a preparatory survey.

Alex Fletcher, Jr. was recently promoted to the position of Senior Water Plant Operator for TVA, with headquarters at Hiwassee Dam, N. C. In this position he has supervision of three plants in Tennessee, three in North Carolina and one in Georgia.

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Maj. John C. Pritchard has been reassigned from his service as Executive to Lieutenant Colonel Underwood, Constructing Quartermaster in the Twin City Ordnance Plant, with headquarters at St. Paul, Minn., to service as Asst. Constructing Quartermaster at a detonator plant at Jacksonville, Ark. Before taking up active duty as a reserve, Maj. Pritchard was a Consulting Engineer in St. Louis, Mo., and at one time he served as Director of Public Utilities for that city.

"**Index to A.S.T.M. Standards, Including Tentative Standards**" has been published as of December 1941. This Index is essential in using the A.S.T.M. *Book of Standards* and its two supplements for 1940 and 1941. The Society's 1,043 specifications and tests are indexed by key words as well as listed in numeric sequence of their serial designations. Copies of the 196-page publication are furnished without charge on written request to A.S.T.M. Headquarters, 260 South Broad St., Philadelphia.

Chain Belt Company has announced the appointment of Dow and Company, Inc., 1820 Elmwood Ave., Buffalo, N. Y., as distributor of Rex Construction Equipment in the Buffalo and Rochester area.

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Report of the North Carolina Section Meeting

The twenty-first annual joint meeting of the North Carolina Section of the A.W.W.A. and the North Carolina Sewage Works Assn. was held November 3–5 at the Sheraton Hotel, High Point, N.C. The total number of registered delegates, including many of the wives, was 243. The Henshaw Cup percentage was 63.7. More than sixty manufacturers' representatives were registered, and exhibit space was provided free of charge to the equipment manufacturers.

The meeting was called to order by Chairman A. O. True of Greensboro at 11:00 A.M. on Monday. High Point's Mayor Arthur O. Kirkman welcomed the delegates in an appropriate and very cordial manner. "The Stone Canyon Inlet-Outlet Line of the Bureau of Water Works and Supply of Los Angeles," a two-reel color movie, was shown through the courtesy of the Barrett Division of the Allied Chemical & Dye Corp. by Thomas F. Kelly, Technical Service Engineer.

James L. Hales, State Director of Public Works Reserve, gave a short talk outlining the work being done by his newly organized department in planning for future public works projects. Aubrey James Setzer, Supt. of Water and Sewer Plants, described High Point's treatment plant facilities, thus supplying a very good introduction for the inspection trips which were made immediately after the close of the afternoon technical session. The inspection trips were very well attended. J. L. Perkins, Director of Public Utilities at High Point, had arranged with local manufacturers for a trip through one of the world's largest furniture factories. Many of the ladies attended a special exhibit the following day.

The City of High Point played host at an old fashioned North Carolina barbecue held at the city Armory at 6 P.M. Monday. This feature proved to be the high spot of the first day's activities, with more than 200 attending.

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Tuesday morning's technical session led off with a paper entitled "Experiences with Cold Water Coagulation at Durham" by J. R. Malone, Chemist, Durham Water Dept. This paper dealt primarily with experiences in coagulation and filtration during the extremely cold weather in 1939, and reviewed the remedial measures employed at the Durham plant.

"Industrial Water Requirements" was the subject of a paper by A. S. Behrman, Chemical Director, International Filter Co., Chicago. This paper outlined the problems encountered in the fields of textile, paper and bottling industries. Emphasis was laid on the problems encountered in this section of the United States. Formal discussion of this paper was presented, first, by Henry Seaman, Chief Water Works Engr. of the Champion Fibre and Paper Co. John L. Brown, Chemist for water treatment at the Cannon Mills, spoke for the textile industry. The final speaker in this discussion was Dr. John M. Sharf of the American Bottlers of Carbonated Beverages who spoke at length on the requirements of his industry.

R. Frank Hill, Engr. for the San. Eng. Div. of the N. C. State Board of Health, read the recent report of A.W.W.A. Committee W-9 on "Standards of Purification Plant Operation." This discussion took the place of the scheduled "Round Table of Water Treatment Problems." The dis-

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cussion following the reading of this report proved to be so lengthy that the Chairman was authorized to appoint a committee of five whose duty it would be to canvass the membership for comments and suggestions relative to the report. The Committee was authorized to bring its findings to the attention of the A.W.W.A. Board of Directors.

An honorary luncheon for the national officers in attendance at the meeting was held at 1 P.M. Those so honored included: Louis R. Howson, President, A.W.W.A.; Arthur S. Bedell, President, Fed. of Sewage Works Assns.; J. E. Gibson, Past-President, A.W.W.A.; William W. Brush, Treasurer, A.W.W.A.; Linn H. Enslow, Chairman, Publications and Program Committee, A.W.W.A.; and Clinton Inglee, Chairman, Executive Committee, Water and Sewage Works Mfrs. Assn. Arthur S. Bedell delivered the principal address. More than one hundred attended the luncheon.

The afternoon technical session was given over entirely to the presentation of papers dealing with sewage treatment. Included were: "Treatment of Sewage Using Intermittent Sand Filters" by Robert H. Grady, Asst. Engr., N.C. Dept. of Conservation and Development. "Water—A Natural Resource," a paper dealing with stream pollution studies, was

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presented by Guy R. Scott, Sen. San. Engr., Tennessee Valley Authority. W. M. Franklin, Supt. of Plants, Charlotte, N.C., led the "Round Table Discussion of Sewage Treatment Problems."

Tuesday evening at 7:30 P.M. more than two hundred attended the banquet. Mayor O. A. Kirkman of High Point acted as toastmaster. The principal feature of the banquet was the address by Louis R. Howson, President, A.W.W.A. Mr. Howson showed slides beautifully illustrating his description of a recent trip to Alaska. Mr. Howson's remarks and illustrations dealt primarily with some of the popular misconceptions most of us have concerning Alaska.

W. M. Franklin, Chairman of the Membership Committee, was awarded permanent possession of the Maffitt Membership Cup. This cup is awarded annually by M'Kean Maffitt, Supt. of the Water Dept. at Wilmington, N.C., to the member who secures the largest number of new members for the Section. Winning three consecutive years earns permanent possession. The cup was presented to Mr. Franklin by L. I. Lassiter of Wilmington.

W. E. Vest, Supt. Water Dept., Charlotte, N. C., was honored by the Association for his long and distinguished service. Mr. Vest has been a member of the A.W.W.A. for thirty years and was one of the founders of the N.C. Section. Mr. Howson presented the membership certificate to Mr. Vest with appropriate remarks and ceremony.

Professor H. G. Baity of the University of North Carolina read the report and citation for the Fuller Award Committee. It was awarded this year to William Christian Olsen, Cons. Engr., Raleigh, N.C.

Following the adjournment of the banquet, a dance was held in the ballroom. Jack Yancey and Orchestra furnished the music. Dancing began at 10:30 P.M. and ended at 2:00 A.M.

The final session was called to order at 10 A.M. on Wednesday and began with a paper by Grover Jones, City Attorney of High Point, who spoke on "Legal Aspects of Sewage Treatment" (see Mr. Jones' complete text in this JOURNAL). "Maintenance of Elevated Water Storage Tanks" was the title of a paper delivered by H. F. Stearns, Dist. Mgr., The Chicago Bridge and Iron Co. (Mr. Stearn's paper is given in full in this JOURNAL). This paper was supplemented by Edward B. Shidell, Electro Rust Proofing Company in a formal discussion entitled "Conservation of Steel With Cathodic Protection."

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Harry E. Jordan, Secy., A.W.W.A., discussed briefly the details of priorities and supplies. This discussion of the problem of procurement of materials proved quite timely and of great interest.

A rather lengthy business meeting was held at which reports were read by the following and approved; the Secretary-Treasurer; Chairman, Membership Committee; Chairman, Stream Gaging Committee; Chairman, By-Laws Revision Committee; and Resolutions Committee. The Convention adopted without dissent the proposed revision of the By-Laws.

The following officers were elected: Chairman—D. M. Williams, Supt., Water Dept., Durham, N.C.; Vice-Chairman—W. J. Parks Jr., Chief Water Works Eng., Camp Davis, N. C.; Secretary-Treasurer—R. S. Phillips, Ch. Chemist, Water Dept., Durham, N.C.; and Trustees—J. H. Henderlite, Chemist, Water Works, Fort Bragg, N. C., and E. D. Burchard, U. S. Geological Survey, Post Office Bldg., Asheville, N. C.

Following the installation of new officers, the convention adjourned at 1 P.M., Wednesday, November 5.

R. S. PHILLIPS
Secretary-Treasurer

Report of the Four States Section Meeting

The twenty-fifth annual meeting of the Four States Section was held November 5–7 at the Lord Baltimore Hotel, Baltimore. The total registered attendance was 177, including the ladies.

On the afternoon of November 5 a golf tournament was held at The Country Club of Maryland, near Towson, Md. That evening, the "Get-Together Party," a feature for the past three years on the evening prior to the opening of the technical meeting, was held in the Florentine Room of the Lord Baltimore Hotel with about 55 early arrivals attending. Chats with old friends, cards, and refreshments constituted the program.

There were 126 in attendance at the Annual Banquet on Thursday evening, following which was announced the selection for the Fuller Award of Carl J. Lauter, Chemical Engr., District of Columbia Water Works. Mr. Lauter was chosen as the recipient of this award for his continued research in, and outstanding contributions to, the fields of bacteriology and filter plant operations, and for his services as an officer of the Four States Section, as officer of the Maryland-Delaware Water and Sewerage Assn., and as Chairman of the A.W.W.A. Water Purification Div.

After a one-hour professional variety show, a 20-minute sound motion picture, "Health and the Cycle of Water," was shown through the courtesy of the Cast Iron Pipe Research Assn. This new film, produced for the purpose of helping interested officials promote public interest in water filtration and sewage disposal plants, includes animated diagrams showing the operation of several types of plants.

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HERSEY

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Edward S. Hopkins presided at the Thursday technical sessions. After an address of welcome by George Cobb, Chief Engr., Baltimore, the morning session was devoted to defense information given by the following speakers: E. A. Soucy, Special Agent in Charge, FBI, speaking on "The Work of the FBI Under the National Defense Plan," Charles Haydock, Cons. Engr., Philadelphia, speaking on "Water Supply in the National Defense," with Adrian Hughes, Director of Research, Baltimore Transit Co., giving a formal discussion; and Abel Wolman, Prof. San. Eng., Johns Hopkins University, speaking on "Utility Organization for Defense."

The afternoon session had the following schedule: "Rehabilitation of the Philadelphia Water Works" by Seth M. Van Loan, Chief, Bureau of Water Supply, Philadelphia, and a discussion by Nathan Jacobs of Morris Knowles, Inc., Pittsburgh (both the paper and discussion are presented in full in this JOURNAL); "Rating of Water Distribution Systems for Fire Protection Purposes" by A. C. Hutson, Asst. Chief Engr., National Board of Fire Underwriters, New York, and a discussion by J. R. McComas, Sen. Asst. San Engr., Maryland State Board of Health; "Chlorinating New Water Mains—a Symposium" led by Carl A. Hechmer, Dept. Engr.,

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Maint. and Operating Dept., Washington Suburban San. Dist., Hyattsville, Md.; and "Standards of Purification Plant Operation—a Round Table Discussion of the Report of A.W.W.A. Committee W-9 as Presented at the Toronto Convention" led by Edward S. Hopkins, Chairman of the Committee.

Carl A. Hechmer presided at the final session, Friday morning, with the following program: "Maintenance of Control Equipment in Water Filtration Plants" by Alan A. Wood, Representative at Philadelphia of Builders-Providence Div. of Builders Iron Foundry, with a discussion by R. A. McQuade, Asst. Sales Mgr., Simplex Valve & Meter Co., Philadelphia; "A Bacteriologist Looks at Chlorine" by Stella M. Costigan, Bacteriologist, Development and Research Dept., Pennsylvania Salt Mfg. Co., Philadelphia, with a discussion by John W. Krasauskas, Bacteriologist, Dalecarlia Filter Plant, Washington, D. C.; "New Standards of Water Quality" by J. K. Hoskins, Sen. San. Engr., Chief, Sanitation Section, U. S. Public Health Service; and "Efficient Maintenance of Motor Driven Centrifugal Pumps" by L. V. Schuerholz, Mech. and Elec. Designing Engr., Bureau of Water Supply, Baltimore, and discussion by Stanley E. Kappe, Research Engr., Washington, D.C.

At the business meeting, the following officers were elected: Chairman, Carl A. Hechmer; Vice-Chairman, J. G. Patrick; Trustees (for two years), R. S. Beckett of Dover, Del., and R. I. Dodd of Chester, Pa.; Secretary-Treasurer, H. Lloyd Nelson; and to succeed Abel Wolman as A.W.W.A. Director after the close of the A.W.W.A. Chicago Convention, I. M. Glace, Cons. Engr., Harrisburg, Pa.

Plans are under way, subject to making satisfactory arrangements for a meeting headquarters, to hold a joint meeting of the New York, New Jersey, and Four States Sections, sometime in October 1942.

The unusually large attendance at the technical sessions, of those registered at the Meeting, gave evidence not only of a greatly increased interest by all the membership in Section and Association affairs, but also of the good work done by the Section Program Committee under the leadership of R. W. Haywood Jr. Credit should also be given to the fine arrangements and entertainment handled by the Local Arrangements Committee under Joseph S. Strohmeyer, Chairman.

H. Lloyd Nelson
Secretary-Treasurer

When should you specify the use of zeolite process for softening water . . . and when should you use the lime and soda process? Answers to these and other questions are outlined in a new publication, No. 112, available from the American Water Softener Co., Lehigh Ave. & 4th St., Philadelphia.

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WATCH DOG
WATER METERS
. . . built to give
LASTING SATISFACTION
The Worthington-Gamon Meters of today represent an experience of 85 years . . . dating back to the invention of the piston meter, in 1855, by Henry R. Worthington.
With 3,650,000 meters now serving thousands of communities, this organization offers to municipalities and water companies a product whose accuracy and low maintenance requirements have proved it to be a sound investment.
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District Sales Offices and Representatives throughout the United States
WORTHINGTON-GAMON

WG1-2A

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For cleaning chlorinators, the commercial product Carbona (carbon tetrachloride) has long been popular for getting clean those parts of chlorine control apparatus which come in contact with the chlorine gas. Carbon tetrachloride is used because it does not react with the chlorine to form secondary products which interfere with the equipment's operation. But shortages in carbon tetrachloride have occurred. A suitable *substitute* for cleaning chlorinators is *wood* alcohol (methanol). Other than Carbona, wood alcohol is the only known chemical widely available and suitable for use in maintaining chlorinators.

Practical information concerning pump adaptation for a wide range of duties under varying conditions is the theme of a new industrial catalog recently published by Pomona Pump Co. The 24-page brochure contains a profusion of illustrated case histories of varied applications, and also presents many practical drawings for laying in this type of pump. Copies are available at no charge to persons writing Pomona Pump Co., 206 E. Commercial St., Pomona, Calif.

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Materials for Munitions

These are times of strict economy. The stringencies of war demand that nothing shall be used save its consumption contribute to the health and safety of the realm. The rationing of many commodities, the shortage of some and the total absence of others have brought home to each of us the vital need of conserving expenditure in labour, shipping and materials. To this end salvage can make an invaluable contribution.

One of the most urgently needed of all salvage materials at the present time is used paper. This is no longer a surplus material for which some means of disposal has to be sought. It is an essential raw material of war industry. Its conversion takes too many forms for all these to be listed here, but as examples it may be noted that one ton of paper can be turned into 1,500 shell containers, or into 71,000 dust covers for aero engines or 11,000 mine assemblies and a host of other vital components. The Ministry of Supply is asking for 100,000 tons of waste paper at once and in anticipation of this demand being met the Waste Paper Recovery Association has been organised to ensure that available supplies shall be collected with the utmost dispatch. We appeal to our readers to help keep this new organisation overworked.

Many of our readers have, no doubt, already cleared away much of their used paper, but we appeal to them to make a fresh examination of their shelves and cupboards. All forms of paper are useful and any unwanted plans and drawings, out of date text books and obsolete catalogues should be disposed of at once. The need is pressing.

In addition to this general clearance it is imperative that a regular supply of waste paper for our munition factories be maintained. This can only be done by a well-constituted salvage organisation. Such organisations are now being built up all over the country and all local authorities are striving to collect the maximum available supplies. Only when all sources are continually drained will the utmost contribution to our shipping problems have been made. Towards this end all must strive. [Reprinted from the December 1941 issue of *Water & Water Engineering* (British).]

To promote the purchasing of Defense [War] Savings Bonds, local Defense Savings Committees are now prepared, with the help and cooperation of the U. S. Treasury Dept., to aid heads of municipal departments and business men in arranging employee participation in voluntary payroll allotment campaigns. Such a system is now in operation in many businesses and most labor organizations have given general endorsement to the payroll allotment method.

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To keep up to date its triennially published *Book of Standards*, the American Society for Testing Materials in the two intervening years issues supplements to each of the three parts of the book. The 1941 Supplement has been published as of December 1941. It gives in the latest approved form the 370 specifications, tests and definitions which are issued for the first time or are revised.

Part I covers metals; Part II includes nonmetallic materials used for constructional purposes; and Part III comprises the following fields: coal and coke, petroleum products and lubricants, electrical insulating materials, plastics, rubber products, textile materials, paper, etc.

Copies of the Supplement, each of which includes correction stickers for affixing in the previous books, can be obtained from the A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, at $3 for any one part, $5 for any two parts, and $7 for all three parts.

Report of the Florida Section Meeting

The fifteenth annual meeting of the Florida Section was held November 13–15 at the Osceola Hotel, Daytona Beach, Fla. The total registered attendance was 110, with 12 wives of members attending.

The meeting was opened at 10 o'clock on Thursday morning, November 13, with an address of welcome by the Honorable U. W. Cunningham, Mayor of Daytona Beach. H. H. Hyman, Chairman of the Section, presided and responded to the address of welcome, following which he outlined the important activities carried out by the Section during the past year.

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This has been one of the most fruitful years in the history of the Section, since it has witnessed the organizing of the Florida Water Works Operators Association, the Florida Sewage Works Association, the ninth annual Short Course in Water and Sewage Treatment given at the University of Florida, the partial completion of a colored motion picture, "Water and Water Treatment in Florida," and the organizing by the General Extension Division, University of Florida, of extension courses in chemistry, mechanical handling of water, and accounting methods for water works men.

Scheduled papers on Thursday morning were: "A Nine-Meeting Review" by William W. Brush, Editor of Water Works Engineering and Treasurer of the A.W.W.A.; "Civilian Defense of Public Water Supplies" by G. E. McCallum, San. Engr., Office of Civilian Defense, Washington, D.C.; and "Water Supply for the Army" by A. S. Behrman, Chemical Director, International Filter Co., Chicago. On the afternoon program were: "The Bacteriological Quality of Florida Ground Waters" by A. E. Williamson, Assoc. San. Engr., Florida State Board of Health; "Ground Waters in Southeastern Florida" by W. P. Cross, Assoc. Engr., U.S. Geo-

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logical Survey, Miami, with a discussion by S. K. Love, U.S. Geological Survey, Washington, D.C.; "Difficulties Facing the Water Works Manufacturers During the Present National Emergency" by Fred E. Stuart, President, Stuart-Brumley Corp., Baltimore; and "Progress in Aquatic Weed Control" by C. P. Wilber, State Forester and Director, Dept. of Conservation and Development, Trenton, N. J.

On Friday morning, Harry E. Jordan, Secy., A.W.W.A., spoke on "Water Works Operations Under Emergency Conditions." The report of Committee W-9, "Standards of Purification Plant Operation," was discussed quite fully by Section members, the discussion being lead by Director Ralph W. Reynolds, with discussions by R. M. Johnson, Supt. of Filtration, Tampa, H. A. Gahn, Supt., Water Plant, City of Ft. Pierce, Thomas Paul, Chief Operator and Chemist, Bradenton, and W. S. Black, Supt., Water Plant, Miami. Following the discussion, the Section voted that the Report not be approved in its present form and that a Committee headed by Mr. Reynolds transmit to A.W.W.A. Secretary Jordan at an early date its specific objections to certain parts of the Report. Keith R. Chinn, West Palm Beach, talked on "Organization and Objectives of the

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Florida Water Works Operators Assn." The session was concluded with J. B. Wilson of the Barrett Div., Allied Chemical and Dye Corp., showing the movie "The Stone Canyon Inlet-Outlet Line Supplying Los Angeles."

One of the most interesting features of the meeting was the first showing of the completed portion of the colored film "Water and Water Treatment in Florida." The film is being sponsored by the Florida Section, the State Board of Health and many municipalities throughout Florida. The picture is being made by A. B. DeWolf of Miami. When completed, it will be available for use by other Sections which desire to see it. "Objectives of the Florida Sewage Works Assn." were described by David B. Lee, Chief San. Engr., Florida State Board of Health; followed by a discussion by S. W. Wells, Chemist, Florida State Board of Health. Mr. Lee is President of the Sewage Works Assn. and Mr. Wells is Secretary.

Before the annual business meeting on Saturday morning, G. E. Ferguson, Dist. Engr., U.S. Geological Survey, gave an illustrated presentation of "Characteristics of the Flow of Streams and Springs in Florida With Regard to Their Use as Industrial and Municipal Supplies."

Another important feature of the meeting was the announcement by G. Manuel Turner of the General Extension Division of the University of Florida that three Extension Courses for Water Works Operators are now ready. One presents the fundamentals of chemistry and will be followed by a course in the chemistry of water treatment. A second course deals with the pumping of water and related problems. The third course deals with methods of water works accounting, problems of municipal organizations and government and public relations, etc. These courses are available at a very low charge to water works men throughout Florida and elsewhere.

The annual business meeting of the Section was held at 11 o'clock on Saturday morning. The following were elected for 1941–42: Chairman, W. B. Gibson, The Johns-Manville Co., Ft. Myers; Vice-Chairman, J.

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R. Hoy, Wallace & Tiernan Co., Jacksonville; Secretary-Treasurer, A. P. Black, Dept. of Chemistry, University of Florida, Gainesville. Trustees are: A. B. DeWolf, Director of Research, Dept. of Water and Sewers, City of Miami; David B. Lee, Chief San. Eng., Jacksonville; H. A. Gahn, Supt. of the Water Dept., City of Ft. Pierce, Florida.

A special Committee under the Chairmanship of J. S. Long, Supt. at Tampa, reported the nomination of Chairman H. H. Hyman as Director to succeed Ralph W. Reynolds whose term of office expires at the Chicago convention. Mr. Hyman was unanimously elected.

The entertainment program included a cocktail party and buffet supper at which members and their wives were guests of the City of Daytona Beach. Climaxing the entertainment program was the traditional annual banquet and dance held on Friday evening. Chairman H. H. Hyman presided as toastmaster and introduced distinguished guests and visitors.

The newly organized Sewage Works Operators Association held a breakfast meeting on Saturday morning. Appropriate resolutions were passed complimenting city officials and Committees on what was described as one of the best meetings in the history of the Section.

A. P. Black
Secretary-Treasurer

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Corporate Members

Centralia City Water Dept. Emil F. Jayne, Centralia, Ill.
East Coast Water Co. Garland S. Sydnor, Box 1476, Richmond, Va.
Rock Island Water Dept. Nicholas J. Hoeltzner, Supt., Rock Island, Ill.

Junior Members

McKay, W. G. Asst. Engr., Dept. of Pensions & National Health, 15 Bank of Nova Scotia Bldg., St. Catherines, Ont., Canada

Affiliates

Hasselgren, R. E. Supt., Water Filtration Plant, Folsom Prison, Box 228, Represa, Calif.
Qualkenbush, Raymond L. Water Service Foreman, C. I. & L. Ry., Monon, Ind.

Reinstatements—Active Members

Clapp, W. J. Supt. of Water Plants, Florida Public Service Co., Orlando, Fla.
Coates, G. W. Supt., Water Dept., 518 Taaffe St., Sunnyvale, Calif.
Fiveash, Charles E. Supt. of Plants, City Hall, Fort Lauderdale, Fla.

Resignations—Junior Members

Sanders, John F. Plant Operator, Boonville Water Dept., Boonville, Mo.

Deaths—Active Members

Dill, Howard A. 1807 Reeveston Rd., Richmond, Ind.
Brown, Robert F. Constr. Engr., California Water Service Co., 374 W. Santa Clara St., San Jose, Calif.

Transfers Between Sections

Cook, James R. From Four States to New York
Gausmann, R. W. From Greece to New York
Kallis, M. A. (Mrs.). From Illinois to Four States

NEWS OF THE FIELD

The Office of Civilian Defense is engaged in an activity unqualifiedly necessary during the present period of emergency. It must not only develop information which will be of aid to American civilians when enemy attack occurs but it must also build up their morale. This morale build-up is needed not only for the period of definite critical emergency but also for all of the time when citizens are going to have to get along without many of the things to which they have been accustomed for so many years.

The publications of the Office of Civilian Defense now amount to a very substantial series of guides for workers in the various fields of activity. There are, for example, a Handbook of First Aid, a Handbook on Air Raid Warning, another for Fire Volunteers, another for Auxiliary Firemen, one for Rescue Squad Leaders. Others are already available and additional ones are in preparation.

In a little ten-page leaflet called "What to Do in an Air Raid," there are found some directions concerning defense against incendiary bombs. The booklet actually says this: "Under raid conditions keep a bath tub and buckets full of water for the use of the fire department in case water mains are broken." In some of the radio addresses which have been given by volunteer personnel engaged in civilian defense work, this sentence has been modified so that listeners understood that they were being instructed to rush to the bath tub and fill the utensils at the moment the warning is heard. It sounds like a little thing and of no importance to the public water supply operator, but if the public takes civilian defense advice seriously (and everyone hopes that the advice that civilian defense workers give will be taken seriously) the danger in this misinterpretation becomes evident. In the average American city during the waking hours of the average individual, he is likely to build up, every hour, a use of about eight gallons of water for all of the things that he does, or in all of the things that are done for his benefit in the city. If, in addition to this hourly average, every individual, after the air raid warning sounded, rushed to fill bath tubs and buckets, he would actually double the demand upon the water supply system at the exact moment when the firemen needed water to put out the fires started by the air raid. No one wants to create a situation such as that—so the suggestion has been made that the advice contained in the Civilian Defense leaflet be amended insofar as its information concerning fire defense activities is concerned, to read as follows:

> If incendiary bombs fall, play a *spray* from a garden hose (never a splash or stream) of water on the bomb. Switch to a stream to put out any fire started by the bomb. Switch back to a spray for the bomb. The bomb will burn for about 15 minutes if left alone, only about 2 minutes under a fine water spray. A *jet splash, stream or bucket of water will make it explode.*

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Keep some tubs or buckets filled with water. This will supply a stirrup pump or a pressure type garden spray with water to fight incendiaries. Store some of this near the attic—close at hand if a bomb lands in the upper part of your home. Keep most of it near the spot you plan to stay when a raid occurs. Add salt in winter to prevent freezing. Add a little oil in summer (a teaspoonful of crank case drainings will do) to keep mosquitos from breeding. Change the water often enough to prevent nuisance. Don't draw a drop from your tap *unless you need it for immediate use* during an air raid. The firemen will need every gallon of water they can get—don't rob them!

If you have a soda-and-acid extinguisher (the kind you turn upside down), use it with your finger over the nozzle to make a spray. Don't use the chemical kind (small cylinders of liquid) on bombs. It is all right for ordinary fires.

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Maurice A. Drubeck, Filtration Designing Engineer of the Chicago Division of Water Purification, was killed late in November in an automobile accident near Lebanon, Mo., in what was reported as a head-on collision with another auto.

Mr. Drubeck was born and educated in Chicago, being graduated in 1924 at the head of his class with a bachelor's degree in mechanical engineering from Armour Institute of Technology. After a short period of employment with a private engineering concern, he was appointed under civil service as a Junior Mechanical Engineer in the Chicago Board of Health. His assignments included smoke abatement, plant examination and ventilating inspection.

From 1928 to 1931, he again served with a private company, then he returned under civil service as Mechanical Designing Engineer in the Division of Water Works Design, Chicago Bureau of Engineering, in which capacity he was assigned to filtration studies. In June of 1931, all filtration activities were transferred to the Division of Water Purification, and Mr. Drubeck made intensive studies concerning the economics of metering and financing of the South District Filtration Plant. His associates credit him with having prepared much of the data on the basis of which a grant of $5,400,000 was obtained by the city from PWA for financing the filtration plant now under construction.

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E. B. Black, senior member of the Kansas City consulting engineering firm of Black & Veatch, was elected President of the American Society of Civil Engineers at their meeting late in January in New York. Mr. Black has been very actively engaged in sanitary and power engineering work for more than thirty years. Before the establishment of the firm of Black & Veatch in 1915, he was with the J. S. Worley Co. which later became Worley & Black. During the first World War, his firm was engaged in the construction of Camp Pike, Mr. Black later being commissioned in the Signal Corps, then being transferred to the Air Corps to supervise aircraft production. In this war the firm of Black & Veatch has been in charge of design and construction of Camp Chaffee, near Fort Smith, Ark.

"You and the War and Blackouts" was an informative article sent all consumers by the Los Angeles Dept. of Water and Power in January 1942. It is a commendable effort to correct and clarify much that has been confused in many civilian minds. The major portion of the article read as follows:

"Blackouts cannot be made by 'pulling a master switch' at a central point. It is up to each citizen to take whatever steps are necessary to make a blackout effective on his own premises.

"A moment's reflection will make it clear why it is impractical and undesirable to shut off the city's electric supply at a central source. To do so would practically wipe out police, fire and army communications systems. Without power to operate pumps, important areas of the city would be without a water supply for fire protection. The same electricity that lights your home also operates your refrigerator, radio and cooking equipment and performs dozens of other services. There is no reason why your home should be deprived of the many related functions of electricity

(*Continued on page 6*)

Clemens Blank, Superintendent of the Construction and Maintenance Dept. of the Indianapolis Water Co., died December 27 at his home in Indianapolis.

Mr. Blank had served the Indianapolis Water Co. for 44 years. He was born in Marion County, Ind., in 1875. After attending business college and working for a short time for a local hardware company, he joined the Indianapolis Water Co. as the fifth member of its office staff. In 1903 he went to Martinsville, Ind., to manage the gas and electric company there, at that time under the control of the Indianapolis Water Co. In 1912 he returned to Indianapolis to take charge of all pipe line work. He later took over the upkeep of general property around the plant and the operation and maintenance of the Canal.

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merely because one function—lighting—must be curtailed during a blackout.

"As a matter of fact, there is no reason why anyone should have to forego the pleasure and convenience of well lighted quarters during a blackout period. It is far better from the standpoint of morale to have the essential rooms of your home so prepared that they can be used in emergencies with no tell-tale speck of light showing on the outside. Then the family can continue with its usual activities instead of huddling in the dark or in the weak light of substitute lighting methods such as candles or oil lamps. Even where such substitutes are employed, the room or home still must have all openings covered so that no light shows from the outside. The common sense procedure is to continue to use comforting electric lights and make your own home a first line of defense against war jitters. . . ."

Criticism of public housing in general may well be indicated by the report from Evansville, Ind., given in the December 9, 1941, National Association of Housing Officials "Naho News." From the study made by the Work Projects Administration, "Naho News" reported:

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"Under the objections listed as project regulations are included such items as prohibition of renting to single persons, lack of accommodations for families of six or more persons, requirements for tenant care of backyards, restriction of pets on the project, and the necessity of paying for excess gas used. The first two reasons are rather significant because they indicate a general neglect so far in the public housing program of housing special groups—that is, single persons, large families, and the aged. There is no indication that objections of prospective tenants to the project are based on the myths of excessive management control and surrender of civil rights, the sort of gossip that has plagued many housing authorities during initial occupancy."

Thomas H. Wiggin and Thomas R. Camp, two leaders in the water works field, were honored at the recent American Society of Civil Engineers meeting. Mr. Wiggin, Consulting Engineer of New York, was given the Rudolph Herring medal for his "noteworthy, painstaking and thorough annual reviews of progress, development and trend in water supply engineering and the water works practice since 1933." Formerly presented annually, these reviews are now published every two years.

Thomas R. Camp, Associate Professor of Sanitary Engineering at Massachusetts Institute of Technology, received the Karl Emil Hilgard hydraulic prize for his paper on "Lateral Spillway Channels."

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Callaghan McCarthy, Watershed Supervisor of the Wanaque Reservoir of the North Jersey District Water Supply, died at home in Paterson, N. J., from a heart attack on December 21. Mr. McCarthy was 59 years old.

He was born in Pittsburgh and educated there. He started his engineering career with the T. A. Gillespie Construction Co., following in the footsteps of his father who had been an engineer connected with the Gillespie firm. Considered an expert on pipe laying, he remained with that concern for 25 years. He first served at Wanaque under J. W. Griffin, who was the first Superintendent at the dam. Mr. McCarthy was Acting Superintendent for 14 months following the death of Mr. Griffin. With the appointment of John McCutcheon as Business Manager, Mr. McCarthy became Watershed Supervisor.

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Seth M. Van Loan, formerly Chief of the Philadelphia Bureau of Water, is now acting as Consultant on Improvements for the Philadelphia water system. Martin J. McLaughlin is now serving as Chief of the Bureau of Water.

L. H. Chamberlain, formerly Manager of the Water Works Sales Section of Crane Company, is now Eastern District Supervisor for The American Well Works, Inc., with headquarters at 165 Broadway, New York.

The Hackensack Water Company has started 1942 with a reserve supply adequate to meet the demands of the 51 communities it serves, thanks to the filling of impounding reservoirs by December rains. C. J. Alfke, Executive Vice-President of the Company, reports that the daily stream flow for 1941 was 76 mgd. and the average pumpage to the distribution system was 36.7 mgd. The average pumpage has shown a modest increase since 1918, when it was 33.4 mgd., to 33.9 mgd. in 1940, and 36.7 mgd. in 1941.

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Report of the New York Section Meeting

The Winter Meeting of the New York Section, or what is known as our "Get-Together" Meeting, was held at the Commodore Hotel on Tuesday, December 30, 1941.

A meeting of the Board of Trustees of the New York Section was held prior to the luncheon and program, at which time there was discussed the matter of a joint meeting to be held in the fall of 1942 with the Four States and the New Jersey Sections of the A.W.W.A. The Secretaries of the Sections concerned were appointed as a Committee to report to their Trustees regarding the matter at a later date.

The following speakers appeared and presented their papers:

Leonard P. Wood, Designing Engineer, Board of Water Supply, City of New York, gave an excellently illustration presentation of "Progress of the Delaware Adequate."

A. F. Dappert, Principal Sanitary Engineer, State Dept. of Health, Albany, N. Y., gave in detail much information under the title "New York State Mutual Aid Plan for Water Service in Case of Emergencies." (Mr. Dappert's paper is presented in full in this issue of the JOURNAL.)

James W. Osteberg of the Technical Research Dept. of the New York City Police Dept. measured up to the title of his talk, "A Comprehensive Picture of Civilian Defense."

An intermission in the regular schedule of the meeting was for listening to Prime Minister Churchill's speech.

A general round table discussion was held after the meeting.

It was voted to hold the Spring Meeting of the New York Section at the Hotel Niagara, Niagara Falls, N. Y., on April 30 and May 1, 1942.

The following resolution was unanimously adopted:

"RESOLVED: that the New York Section of the American Water Works Association wishes to record its appreciation of the splendid work

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accomplished by the Special Committee (A.W.W.A. Defense Committee) in contacting and co-ordinating our efforts to obtain proper maintenance, repair and supply materials needed for serving water to our cities and communities.

R. K. BLANCHARD
Secretary-Treasurer

Baxter F. Wade, Sanitary Engineer for the Greensboro, N. C., Health Dept., has resigned that position to become Superintendent of the water and sewerage system at Jackson, Miss.

Punitive Action by the Division of Priorities of OPM has been revealed in numerous cases since the action last October against a Chicago aluminum company. Lieb and Buchalter, a Brooklyn, N. Y., plumbing supply house, attempted to place an order for brass pipe and copper tubing with a false statement that the order was entitled to an A-10 rating. Another case is that of the State Metals & Steel Co., Inc., which delivered 153,234 lb. of aluminum utensil scrap to Central Aluminum & Flux Co.,

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Garfield Heights, Ohio, for remelting, without a preference rating or authorization from the Director of Priorities. All priorities assistance has been denied the plumbing supply house for a period of two and a half months, and the State Metals & Steel Co., Inc., is denied priorities assistance for over six months. Similar action has been taken against several other firms, priorities assistance being suspended in each case for a period of from six to eight months.

E. C. Schroeder, for many years Manager of the Manitowoc, Wis., water works plant, has resigned that position, and W. C. Staeffler, formerly Asst. Secy. for the Manitowoc Public Utilities Com., has been made General Manager. Engineer for the Commission is now Richard E. Cannard.

"**Employee Organization for Fire Safety**" is a 48-page publication recently prepared by the Executive Office Staff of the National Fire Protection Assn. Copies are available at 25 cents each from N.F.P.A. headquarters at 60 Batterymarch St., Boston. Documents relating to war-

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time fire protection published by N.F.P.A. now number twenty according to a recent folder.

James C. Harding, Consulting Engineer of New York, has accepted the post of Commissioner of Public Works of Westchester County, N. Y. Mr. Harding's predecessor was Charles H. Sells who recently accepted the job of Chief Engineer for a $200,000,000 American-British defense project in the Middle East.

Mr. Harding has been an Active Member of the A.W.W.A. for the past twenty years and is currently serving as Co-Chairman of the Association's Committee 4A—Deep Wells and Deep Well Pumps. He has engaged in private practice with offices in both Mt. Kisco, N. Y., and New York City for the past fifteen years. He was previously with the firm of Fuller & McClintock.

E. Shaw Cole, who for many years has served as Engineer with the Pitometer Company, has been promoted to the position of Chief Engineer with that firm of engineers, a position formerly held by Edgar K. Wilson

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who remains as Treasurer and will act as Consulting Engineer for the firm.

Before joining The Pitometer Company, Mr. Cole had been associated with Newsom and Aldrich, Engineer-Consultants of New York City and Harrisburg, Pa., after having received a Master's Degree in sanitary engineering from New York University in 1939.

The Public Administration Service, 1313 East 60th St., Chicago, has recently issued a folder describing numerous publications covering: Education for Administration, Federal Work Relief, City Manager Government, Federal Aid—How It Works, Public Employment Service, etc. Numerous monographs have also been issued, including: Films as an Aid in Training Public Employees, Public Personnel Administration, Public Budget Administration, etc.

Standard and special butterfly valves for control and shut-off of air, gas, steam, liquids and semi-solids, under high and sub-zero temperatures and pressures varying from 2 to 300 psi., are so described in Catalog 10-B recently issued by R-S Products Corp., 4530 Germantown Ave., Philadelphia. Included in the 16-page publication are flow charts, specifica-

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tions, descriptions of manual and automatic control, and discussions of the uses of many different metals.

Aqua-Clear is a new product recently announced by the Sudbury Laboratory, South Sudbury, Mass. It is a clear liquid to be added to water in the amount of one ounce to each 100 gal. of water and is developed for the purpose of preventing rust and providing clear water from any metal tanks or pipes. Descriptive circulars and complete information may be obtained from the Sudbury Laboratory.

Servicised Products Corp., 6051 West 65th St., Chicago, has announced a new "Waterstop Expansion Joint" recommended for dams, swimming pools, basement walls and floors, etc. The joint is designed to prevent water leakage where there is extreme expansion or contraction of concrete slabs. Also announced by Servicised Products Corp. is a new hot poured rubber sealing compound known as "Para-Plastic."

Aims and objective of the Public Work Reserve:

1. To encourage and assist in listing the needs of each state and municipal government in the fields of public service and capital improvement.

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PROFESSIONAL SERVICES

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2. To promote the policy of long-range planning of useful public services and of needed capital improvements on state, county and local levels, so that programs of worthwhile work will be available when needed.

3. To aid and encourage the governmental bodies in wisely programming for a period of years their services and improvements, on a priority basis of relative need and expediency.

4. To encourage and possibly assist in expediting the advance preparation of designs, plans and specifications of such public improvements in order that they may be ready for accomplishment at the opportune time.

5. By so doing to establish on a national scope a known reserve of useful public work which can be used to stabilize employment during periods of economic stress such as may be expected at the close of the present defense activity.

Long-range programming: The preparation by a State or local government of a long-range program of public work involves four major steps, of which the first two may be accomplished concurrently.

1. Listing of Needed Services and Improvements. Each department of the governmental unit involved submits to an individual or body designated by the chief executive essential data on all proposals for consideration. These include a description of the work, statements in justification, preliminary plans and estimates of construction or acquisition costs, and estimates of operation and maintenance expense. Each department arranges its proposals in tentative order of priority.

2. The Financial Analysis. The appropriate financial officer or department of the local government conducts a thorough analysis to determine the local government's approximate ability, present and future, to finance construction and operation of the proposals which may be included in the operation. This is based on past experience, present conditions, and probable trends in local finance. It amounts in reality to comprehensive financial planning by the local government.

3. Preparation of the Program. The program results from a reconciliation of data assembled in the two preceding steps. It is developed by a comprehensive agency of the local government under authorization of the chief executive. The development of the program is premised on a balanced relation of needs and probable ability to finance, on established policies, on basic plans and studies, and on the public attitude. All of these guide the selection of services and improvements to be scheduled and of their order of priority.

4. Legislative Consideration of the Program and the Resulting Capital Budget Recommendations. Following preparation of the program, a one-year capital budget is submitted by the local programming agency to the local governing body for consideration and action.

Public relations: Little can be expected from long-range programming

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unless it has public approval within the community. Consequently, it is important that the citizens be acquainted with the idea at an early stage of the programming operations, and then be kept informed of progress in order to forestall possible defeat resulting from confused or inadequate understanding of the issues.

Period of the program: Programming should neither be for too short a period to develop its benefits nor for such a long period that it becomes vague and uncertain.

The Public Work Reserve suggests a 6-year period for states and municipalities because it is both convenient and practicable. Congress has provided in the Employment Stabilization Act of 1931 that federal construction shall be programmed on a 6-year basis. Programs for less than four or more than ten years either do not provide the advantage of the long-range view or become unrealistic in attempting to provide details too far ahead.

"Health and the Cycle of Water" is a sound motion picture produced for The Cast Iron Pipe Research Assn. by Audio Productions, Inc., New York. Showings of it are available for local groups upon application to Thomas F. Wolfe, Research Engineer, Cast Iron Pipe Research Assn., Peoples Gas Bldg., Chicago. The trials and tribulations of a small town's efforts from 1890 on to obtain good water and prevent stream pollution are depicted. Animated diagrams in the movie review numerous methods and equipment designs for treating water. There are available two versions of the movie: one is a 2-reel film of 20 minutes duration and the other, a 3-reel picture of 30 minutes showing time. The third reel shows laboratory and engineering tests of pipe.

The next annual meeting of the Midwest Power Conference will be held on April 9–10 at the Palmer House, Chicago. This Conference is sponsored by the Illinois Institute of Technology with the co-operation of

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nine other midwestern universities and colleges and the local sections of the Founder and other engineering societies.

The directorate of the Conference, according to Stanton E. Winston, Director, cognizant of the fact that the need in the present war effort is power, and even more power, is doing its utmost to provide a program for this annual meeting which will not only uphold the tradition of the Conference but will also provide a stimulus in the present emergency. It is the opinion of the directorate that the present emergency makes the annual meeting of the Conference more urgent than ever before.

The preliminary program of the Conference will contain, in addition to the opening meeting, sessions on Electric Power Transmission, Industrial Power Plants, Hydro Power, Fuels and Combustion, Diesel Power, and Central Station Practice. The latter is sponsored by the Chicago Section of the A.S.M.E. and all arrangements for it are being made by the section's chairman of its Power and Fuels Division, J. R. Michel. In addition to these sessions, the Conference program will include two joint luncheons, one with the Chicago Section of the A.S.M.E. and the other with the Chicago Section of the A.I.E.E. A high light of the Conference will be its All-Engineers Dinner on the evening of April 9.

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The Conference will be opened by President H. T. Heald, of the Illinois Institute of Technology and Dr. A. A. Potter, Dean of Engineering of Purdue University. Among the papers and speakers of the Conference program are the following:

Boiler Circulation Problems by A. A. Markson, Member A.S.M.E., New York.

Recent Field Experience with Natural Lightning by C. F. Wagner, Manager, Central Dept., Westinghouse Electric and Mfg. Co.

Lightning Proof Line Design by A. C. Monteith, Manager, Industry Engineering Dept., Westinghouse Electric and Mfg. Co.

Power in the Flour Milling Industry by A. R. Ulstrom, Engineer, Cereal Engineering and Construction Co., Minneapolis.

Feedwater Treatment in Small Power Plants by E. P. Partridge, Director of Research, Hall Laboratories, Inc., Pittsburgh.

Power Setup at the Aviation Plant of Buick Motors by H. S. Golden, Assistant Chief Engineer, Buick Aviation Div.

Preventing and Extinguishing Electrical Oil Fires by H. W. Eales, Chief Electrical Engineer, Public Utility Engineering and Service Corp., Chicago.

Radial Diesels by Professor E. T. Vincent, University of Michigan.

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The Preliminary Program, when issued in the latter part of February, is also expected to include the following papers:

Experience with Priorities for Equipment and Maintenance.
Industrial Production and the Welfare of the Nation.
Furnace Design Development.
Prevention of Outages on Transmission System.
Minimizing the Effect of Faults on Transmission Systems.
Water Power Development in the Light of War Industrial Activity.
Silting of Water Power Reservoir.
Results Obtained by Spreader Stokers with Continuous Ash Discharge.
Procurement of Fuels.
Diesel vs. Steam Locomotives.

The Preliminary Program will be distributed toward the latter part of February. Everyone interested in the field of Power is cordially invited to attend the Conference. All inquiries with respect to the Conference may be addressed to either Stanton E. Winston, Conference Director, or Charles A. Nash, Conference Secretary, c/o Illinois Institute of Technology, Chicago.

Report of Kentucky-Tennessee Section Meeting

The annual meeting of the Section was held at the Andrew Jackson Hotel in Nashville, Tenn., October 27–29, 1941. After the call to order on Monday morning, Mayor Thomas L. Cummings of Nashville gave an Address of Welcome in which he stressed the responsibility of water works men in performance of their duties during the present emergency.

The Committee report, "Proposed Standards for Purification Plant Operation," was read and reviewed by B. E. Payne of the Louisville Water Co. Some sections of the Proposed Standards were found to be in conflict with operating practice in both Kentucky and Tennessee. It was considered necessary to refer the report to a committee composed of members from both states for study, after which a report is to be submitted to A.W.W.A. Secretary Jordan.

A. E. Clark, Engineer with the Public Works Reserve, explained the purpose of this newly formed organization to be as follows: To collect data on needed public works projects; to assist in outlining and preparing plans and specifications, especially for non-federal agencies; and to follow up inventories and needs of various communities.

A joint paper by W. G. Stromquist and L. H. Clouser of the Tennessee Valley Authority on "Relationship of River Dams to Community Water Supplies" brought out a considerable amount of discussion. This discussion involved construction difficulties encountered, algae troubles and

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changes in chemical characteristics due to impoundage. No particular changes in algae forms or chemical content have yet been noted and pollution hazards caused by impoundage have not yet appeared to be of consequence.

Charles J. Leary, Universal Construction Company, and H. F. Stearns, Chicago Iron Works, gave papers on "Maintenance of Elevated Tanks and Standpipes." (These papers were published in full in the January JOURNAL.) These were followed by a discussion by E. W. Richardson of The Electro-Rust Proofing Co.

John M. Holladay, Chairman of the Water Commission, Camden, Tenn. (population 992), gave an excellent paper on "How to Make a Small Water Works Self-Sustaining." He brought out the fact that, regardless of the size of the system, business methods must be used to obtain results. High salaries and elaborate equipment are, of course, out of the picture, but by careful management on the part of civic-minded individuals the system can be properly maintained and an adequate reserve fund can be set up for normal expansion, replacements and emergencies.

The discussion on "Priorities for Water Works Materials" was con-

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ducted as a "question and answer" series by George S. Gillen of OPM. A number of questions concerning priorities were answered by Mr. Gillen.

A paper on "Water Works and National Defense" was given by Thomas M. Niles, Greeley and Hansen, Engineers, and a paper on "Problems and Limitations in Extension of Service Beyond the City Limits" was given by M. B. Whitaker, Superintendent of Water Works, Knoxville, Tenn.

A.W.W.A. Secretary Jordan gave a most interesting report on damage to water works utilities in England and methods used to repair damage done. He stressed the fact that no major water works structure had been hit or damaged at any time. Damage has been confined quite largely to the distribution system and now less than 10 per cent of the damage has yet to be permanently repaired. He cited the necessity for being on the alert in our own country should necessity arise. (This was before Pearl Harbor!)

A paper, "A Comprehensive Survey of Large Meters in Nashville," was given by R. L. Lawrence, Supt. and Ch. Engr., and Alan Sharp, Sen. Asst. Engr. of the Nashville Water Dept. They outlined the method of making the tests and brought out the fact that by careful testing and control of the large installations about $17,000 annually could be added to revenue, in the case of Nashville. (See the complete presentation in the January JOURNAL.)

Time permitted only short discussion of the following round table topics: Shortage of Water, Stream Pollution and Water Supply, Licensign

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of Operators, and Activities in Which the Section Should Engage. On the latter topic it was suggested that work might be done in the preparation of inventories of materials and arranging to take active part in educational activities now being carried on in both states.

Officers for the coming year are as follows: Past-Chairman, H. C. Bristol; Chairman, R. R. Harris; Vice-Chairman, John J. Quinn; Trustee, Clark Cramer; and Trustee, G. R. Kavanagh. Howard D. Schmidt continues his term as A.W.W.A. Director and was re-elected Secretary-Treasurer.

The Section chose R. P. Farrell to receive the Fuller Award for his work in connection with developing a program for the Rating and Approval of Public Water Supplies.

Prizes for obtaining new members were awarded to R. P. Farrell, H. N. Jernigan, Howard D. Schmidt, G. R. Kavanagh, J. Wiley Finney, John T. Guthrie, R. R. Harris and H. C. Saindon. The prizes were Defense Savings Stamps.

Howard D. Schmidt
Secretary-Treasurer

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Welding Codes, Standards and Specifications listed below are available from the American Welding Society, 33 West 39th St., New York.

* Welding Symbols and Instructions for Their Use—1940 Edition, 25c
* Definitions of Welding Terms and Master Chart of Welding Processes—1940 Edition, 25c
* Standard Qualification Procedure—1938 Edition, 25c
* Qualifying Welding Operators for Important Work—1940 Edition, 5c
* Tentative Specifications for Iron & Steel Arc-Welding Electrodes—1940 Edition, 25c
* Standard Methods for Mechanical Testing of Welds—1940 Edition, 25c
* Code for Fusion Welding & Gas Cutting in Building Construction, including Appendices on Specifications for Filler Metals; Qualification Tests for Operators of Welding Equipment; Recommended Welding Practices and Welded Symbols—1937 Edition, 25c

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* Code for Resistance Welding of Structural Steel in Building Construction—1935 Edition, 5c

* Specifications for Welded Highway and Railway Bridges—Design, Construction and Repair—1938 Edition—Members 75c Non-members $1.00

Practical Design of Welded Steel Structures by H. M. Priest, 25c

Reports of Structural Committee—

- Welded Structural Joints—Test results and committee recommendation, 25c
- Investigations of Welded Seat Angles, 25c
- Welded Beam—Column Connections, 25c
- Behavior of Fillet Welds When Subjected to Bending Stresses, 25c

* Rules for Fusion Welding Steam, Oil or Air Piping in Marine Construction—1938 Edition, 25c

* Code for Fusion Welding & Flame Cutting in Machinery Construction—1935 Edition, 25c

* Rules for Field Welding of Storage Tanks—1940 Edition, 25c

* A.W.W.A. & A.W.S. Tentative Standard Specifications for Elevated Steel Water Tanks, Standpipes & Reservoirs—1940 Edition, 30c

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* Recommended Procedure to be Followed in Preparing for Welding or Cutting Certain Types of Containers Which have Held Combustibles —1940 Edition, 10c

* A.S.A. Code for Pressure Piping—1935 Edition, $1.00 + postage Note: A.W.S. cooperated in preparation of chapter on Welded Pipe Joints

* A.S.M.E. Code for Unfired Pressure Vessels—1940 Edition, $1.50 + postage Note: A.W.S. cooperated in preparation of Rules for Fusion Process of Welding.

* A.P.I.—A.S.M.E. Code for Unfired Pressure Vessels for Petroleum Liquids and Gases—1938 Edition, $1.25 + postage

* Inspection Method Used in Manufacture of U-69 and U-70 Pressure Vessels—1939 Edition, 5c

Filing Classification of Welding, Brazing, Soldering and Cutting Processes, Materials and Applications, 50c

Report of Committee on Welded Rail Joints, $1.00

American Society for Testing Materials—Impact Symposium, $1.00

* SPECIAL OFFER—Complete set starred codes obtainable in Flexible Binder with name of purchaser in Gold Lettering on Cover for $10.00

The American Welding Society will supply interested persons a list of books on welding, and there is also available a bibliography of important articles on weld inspection which have been published in the *Welding Journal* since 1930.

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Resignations—Active Members

MILLER, WALLACE T. Supt., Board of Water Comrs., Municipal Bldg., Ossining, N. Y.
EVANS, WILLIAM J. Civ. Engr., Box 819, Oxford, N. C.
WEST, CHAS. C. Gen. Mgr., Sayre Water Co., Sayre, Pa.
WALKER, JOHN A. Water & Elec. Supt., Stroud, Okla.

Deaths—Active Members

BLANK, CLEMENS. Supt. of Constr. & Gen. Maint., Indianapolis Water Co., 113 Monument Circle, Indianapolis, Ind.
KELLER, GEORGE JOHN. Secy. & Gen. Mgr., Iowa City Water Co., Iowa City, Iowa

Transfers Between Sections

ATKINSON, GEORGE E. From Montana to Virginia
SEUFER, PAUL E. From Pacific Northwest to Virginia

NEWS OF THE FIELD

Is there a need for an auxiliary water supply service as a part of the Civilian Defense organization in the various cities? Under the plan which has been set up for "Civilian Protection Organization for a Municipality," one finds auxiliary firemen, auxiliary police, air raid wardens, fire watchers, road repair and decontamination squads, etc. In every city where the defense organization has reached any magnitude, many persons are enrolled under each one of these categories of volunteer participation. Grouped under the heading "Emergency Utility Service" in the OCD manual are blackout, warning and repair squads. The functions of these groups are: "Making necessary dispositions, installations and plan to effect quick blackout. Installing public warning systems. Keeping public services in working condition."

What is implied by these statements? We know that much has been done in some areas and little in others to prepare for blackouts. We know that sirens and whistles of one type or another have been installed in some cities and given a trial. In others little has been done. We also know that water, electric, gas and other public utility executives have done a great deal to prepare to meet emergency conditions within their own fields—although they may have said less about it than the best public relations policy might indicate to be desirable.

What are some of the facts affecting all civilian defense work that have a bearing upon the organization of emergency utility services? The primary fact is that civilian defense work of one sort or another is attractive to thousands of persons who wish to do their part in this total war. The millions who are now in active military service have left behind them other millions who recognize that the men in the field can be kept there effectively only by the organized work of civilians. But, the mere carrying on of production is less than many want to do. They want to join the civilian army and play their part in home defense. They know that with home defense, production keeps up and the army and navy are better served.

Another fact to remember is that much of the civilian defense work gains if being a part of it lets the worker wear some sort of uniform. Many have been a bit amused at the profusion of uniforms, arm bands and insignia. We should not be amused. Those insignia help build up the morale of the people who are doing the work—and do not assume for a minute that it is not work. Do you know someone engaged in Red Cross

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activity? If you do, you know that it takes time and energy. Do you know an airplane spotter? There are about 150 of them for every post and there are many hundreds of posts in this country today. Those people are deadly serious—properly so; and they do work hard while on duty.

Contrasted to these facts is another one—preparation for civilian defense can go profitably only so far academically. This is true of any civilian or military training program. A chemist or a blacksmith or a lawyer or a soldier or an air raid warden needs training. But training eventually must move into the field of action or the fervor lapses. A fire watcher can be told what to do *if* an incendiary bomb falls, but after a time nothing but an actual bomb will keep that watcher on his toes.

What does all of this mean when we consider the need for "Auxiliary Water Wardens?" (Do you want to call them by that name?) What are the water works problems under military attack? It is no military secret that not a single pumping station was hit in England during the blitz. But neither is it a military secret that the fall of both Hong Kong and Singapore was hastened by the interruption of water service. The lesson, however, of those cities' fall is not that the water lines were broken, but that the military attack was too severe for the available military defense. Let's keep our thinking straight. The failure was not a lack of civilian defense, but of military defense.

London and the other English cities have much to teach us about civilian defense of water supply. Their problem was primarily one of repairing bombed water distribution mains and the restoration of service for fire fighting and domestic supply. It was the damage done by the earthquake and the flood and the sub-zero weather of peacetime days concentrated into an infinity of broken water pipes in the muddy mess of bomb craters. It called for the emergency repair crews that every water works has organized. But it called for many such crews and their equipment where the routine of good management in times of peace calls for only one or a few. It is dirty work, wet work and cold, that must go on till the repair is made. Overtime and holidays are not respected by the broken water mains, and the American public expects water—even in wartime.

Is that a job for volunteer participation? Our British friends found out that from the actual labor standpoint it was not. In the height of the blitz London had a labor pool of over 18,000 men and almost 7,500 of them were at work on restoration of utility services.

But the crews that work on water main repair need supervision. If a real attack comes to America, utility service restoration will need a crew of foremen to see that the repair work is done properly and quickly. That may be a place for civilian water wardens—unless water departments find a way to train ten to twenty men of their own for every repair crew foreman they now have. The mutual aid system already gives promise

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of making available to a city under emergency conditions, the leadership and equipment available in all their neighboring communities. Will that suffice? Should every water works have local civilian aid?

Now is the time for water works men to discuss these questions in conference and decide whether they want a civilian aid organization in emergency. If they do, what form and extent do they wish it to take?

Fourteen permanent sub-contracting exhibits are now established in industrial centers of the nation. Their purpose is to show small manufacturers how they can turn their facilities to war production, and to help prime contractors and government procurement agencies find additional manufacturing facilities for war material. Current reports indicate that varying stages of organization and success in sub-contracting have been attained in different centers. The sub-contracting functions through the display of parts or descriptions of machines needed by the prime contractor. Small manufacturers or sub-contractors come to the exhibit

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Arthur H. Pratt, a Consulting Engineer and also Chief Hydraulic Engineer of the Public Service Commission of New York, died at the age of 67 on February 1 at his home in South Orange, N.J.

Mr. Pratt was born in Marlboro, Mass., in 1874 and attended schools in Boston and Brooklyn Polytechnic Institute. His early experience included service as a member of the Metropolitan Sewage Commission of Massachusetts; the Brookline, Mass., Engineering Dept.; the U.S. Engineering Dept. at Philadelphia; the Fourth Lighthouse Dist., Philadelphia; and the Highway Office of the New York State Dept. of Engineering, Albany. In 1906 he became an Assistant Division Head of the Board of Water Supply of New York City, assisting in the building of the Catskill aqueduct system. In 1915 he became an Assistant Engineer of the New York Sewer Plan Commission.

After service as Assistant Engineer of the Sewer Bureau of Manhattan, Mr. Pratt served abroad in World War I as Major in the Twenty-sixth Engineers. From 1919 to 1928 he was first Deputy Chief Engineer, then Chief Engineer of the Wanaque water system for Newark, N.J., and neighboring municipalities. He was also Construction Engineer of the North Jersey District Water Supply Commission and the Passaic Valley Water Commission.

Mr. Pratt had been an Active Member of the A.W.W.A. since 1923. He was also a member of the American Society of Civil Engineers, the Society of American Military Engineers and the National Society of Professional Engineers.

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to see what is wanted that they can produce, or perhaps what machine is wanted that they may lease. Water works men who may possess or know about facilities or machines are urged to study, whenever feasible, the exhibits in the locations listed below.

Detroit—Boulevard Bldg., 7310 Woodward Ave.
St. Louis — Boatmen's Bank Bldg.
Philadelphia—Broad St. Station Bldg.
New York—Chanin Bldg., 122 East 42nd St.
Los Angeles — Western Pacific Bldg.
Cleveland — Union Commerce Bldg.
Chicago—Civic Opera Bldg.
Atlanta, Ga. — Mutual State Bldg.
New Orleans—Canal Bldg.
San Francisco—Whitcomb Hotel
Memphis, Tenn.—Sterick Bldg.
Buffalo, N.Y.—White Bldg.
Newark, N.J.—Globe Indemnity Bldg.
Boston—Court St. Branch, 1st Nat'l Bank

Charles H. Capen, formerly Engineer for the North Jersey District Water Supply Commission and recently on leave of absence to serve as Principal Sanitary Engineer of the U.S. Engineer Dept. in the Second Corps Area, has been appointed Chief Engineer for the North Jersey District system. In his new position, he is the first to hold the title of Chief Engineer since the Wanaque system was organized eleven years ago to supply eight communities in northeastern New Jersey. In his new position he is administrative head of the system; previously the administrative control had always been placed with the superintendent or business manager. Mr. Capen has served the Commission for sixteen years.

Mr. Capen, who is a graduate of Cornell University, has been very active in the water works field, having been an Active Member of the A. W. W. A. since 1930. He received the Fuller Award in 1938, has served as Chairman of the New Jersey Section and on the A. W. W. A. Publication Committee.

The need of utilities having some telephones with unlisted numbers was demonstrated on a recent Sunday morning when all three telephones in the Distribution Dept. of the Indianapolis Water Co. started ringing. Consumers jammed all three wires with their queries about service interruption, so that the emergency man on duty could not call out and so that Water Company officials and employees could not get in touch with the Company to see if they were needed. The main break was repaired in good order, thanks to the fact that the key men listened in on the police short-wave sets and thereby found out quickly where the break was.

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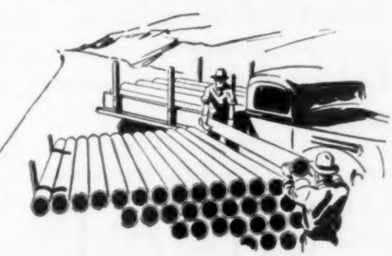
FROM TRAIN INTO TRENCH

K&M "Century" Pipe holds down costs

Hauling . . . "Century" Pipe's light weight permits bigger loads . . . the shipment arrives more quickly at the site, and the trucks are more readily available for other work.



Handling . . . "Century" Pipe's light weight minimizes the problem of unloading and handling.

Installing . . . Here again, "Century" Pipe's light weight will reduce expenses, for two men can easily lower it into the trench without the need of bulky, mechanical equipment.

THE moment you purchase K&M "Century" Pipe you'll start economizing. For "Century" Pipe is so light in weight that, from train to trench, it keeps costs down to a minimum.

"Century" Pipe will lower your labor costs, too . . . for workmen can quickly make tight, flexible joints. With the new "Century" 18 foot lengths, further economies are made possible because of a 28% reduction in the number of joints per mile. The 18 foot lengths are available in 6″ and 8″ sizes, class 150.

Installed in the trench, "Century" Pipe is practically maintenance-free. It never tuberculates, corrodes, nor is it subject to electrolysis . . . hence no protective coatings or linings are necessary.

Get full information on this leader in low-cost-per-mile by writing for our free booklet, "Mains without Maintenance." Address Dept. 1017.

● "Century" Pipe is still available. Since we are cooperating fully with the war program, we cannot tell how long this favorable situation will continue.

KEASBEY & MATTISON
COMPANY. AMBLER, PENNSYLVANIA

K&M best in asbestos

(*Continued from page 6*)

Large users of coal and coke, especially utilities and industrial users, are being urged by the Division of Industry Operations to build up their inventories as much as possible to avoid the danger of having to suspend operations in case of an emergency.

General Inventory Order M-97, issued on February 13, revokes the inventory restrictions imposed by Priorities Regulation No. 1 insofar as they apply to coal and coke. This order was issued upon recommendation of the Office of Solid Fuel Co-ordinator.

The order will enable large users to take advantage of the fact that there is at present considerable excess production of coal and coke, and transportation available for distribution of these materials.

Inventory restrictions are relaxed for coal and coke only. Inventories of all other materials must be kept to a practicable working minimum in accordance with the terms of Priorities Regulation No. 1.

The Tire Rationing Regulations of the OPA, dated December 30, 1941, contain provisions of particular interest to water companies. Listed among the "eligible vehicles" which may be equipped with new rubber tires or tubes are trucks operated for "transportation of material and

(*Continued on page 10*)

(Continued from page 8)

equipment for the construction and maintenance of public utilities." The term "public utilities" is defined as including "gas, electric, and water supply systems, telephone and telegraph systems, transportation systems the facilities of which are available to the general public (railroads, air lines, street car lines, etc.) and similar public service institutions, whether publicly or privately operated."

The regulations state that "certificates may be issued for any truck used to transport supplies, material and equipment for the construction, maintenance and repair of public utilities, as defined above."

However, certificates will not be issued unless the applicant can establish a need for new tires.

The necessary certificates are issued by Local Tire Rationing Boards and application for tires must be made to them. Application blanks may be obtained from the local boards or from approved tire dealers and garages.

No sales of tires or tubes are to be made without certificates for any persons having preference ratings issued by the priorities division. All persons holding priority ratings will apply to local rationing boards for

(Continued on page 12)

(Continued from page 10)

tires but they do not receive preferred treatment because of holding such priority ratings.

No priorities assistance is planned for the construction of air raid shelters, according to the announcement late in January by J. S. Knowlson, then Director of the Division of Industry Operations of WPB. This decision was reached as the result of a careful analysis of the materials that would be required to provide shelters, it being demonstrated that 4,750 lb. of steel would be needed for a reinforced concrete shelter for 24 persons. Obviously, the steel for shelters for only the coastal populations would be a fabulous amount. WPB was officially represented in the conference by Maury Maverick, Chief of the Government Requirements Branch, and Major-General L. D. Gasser represented OCD.

Mayor F. H. LaGuardia, then Director of OCD, issued the following statement:

"The United States is fighting a war to keep enemies away from American shores. Steel and other scarce materials must be made into weapons

(Continued on page 14)

(*Continued from page 12*)

to send to our own armed forces and to our allies on the fighting fronts. Home defenses with huge quantities of steel take away what is needed for our own soldiers and sailors and weaken the arms of the men now actively engaged in fighting the Axis forces. We want to keep the enemies away; to use our critical materials at home will really make the ultimate danger greater. Steel in guns and tanks and ships is better protection than steel in American air raid shelters."

Similar long-range planning is indicated by announced plans of OCD to use substitutes, wherever it is safe to do so, in civilian defense requirements for fire hose, surgical instruments and dressings, protective helmets, boots (to be made from reclaimed rubber), and protective clothing for wardens. Black paint, board or textile coverings for windows of private plants working on war orders will be available, but officials have not recommended providing such materials for private buildings or homes.

Alan D. Drake, who has been serving as Senior Engineer, Airport Section, Engineering Branch, Corps of Engineers, U. S. Army, on March 1 resumed duties at his old position of Director of Water at Buffalo, N. Y.

(*Continued on page 16*)

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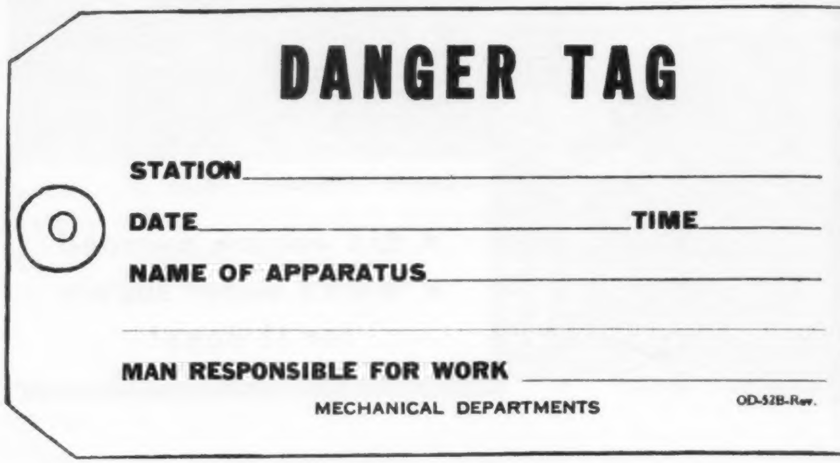
Tags for the protection of workmen were described in the October 1941 "The Water Analyst," published by the Atlantic Utility Service Corp. The fronts and backs of three tags are reproduced here in the following order: (1) Standard Danger Tag for use in tagging valves, boiler


DANGER TAG

STATION

DATE TIME

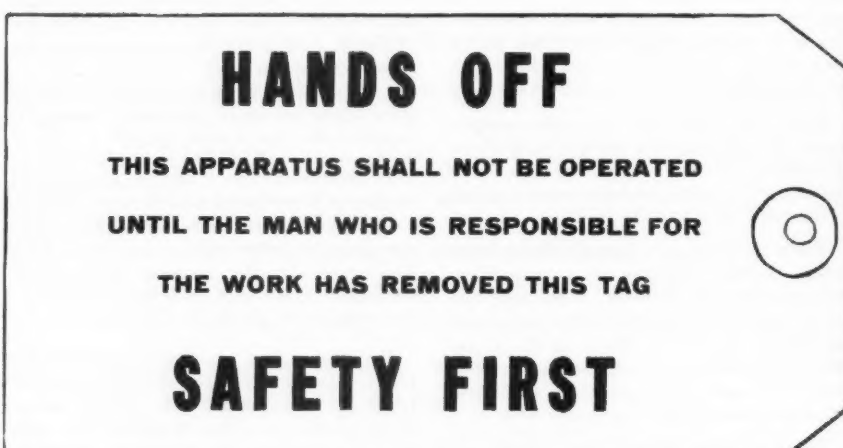
NAME OF APPARATUS

MAN RESPONSIBLE FOR WORK

MECHANICAL DEPARTMENTS

OD-52B-Rev.

Standard Danger Tag—Front


HANDS OFF

THIS APPARATUS SHALL NOT BE OPERATED

UNTIL THE MAN WHO IS RESPONSIBLE FOR

THE WORK HAS REMOVED THIS TAG

SAFETY FIRST

Standard Danger Tag—Back

openings, or other mechanical equipment in plants; (2) Red Tag for the protection of men working on electrical apparatus; and (3) Blue Tag for the protection of men working during tests, etc. It is to be noted that the Red Tag is for use on lines which must not be made alive. The

(*Continued on page 17*)

(*Continued from page 16*)

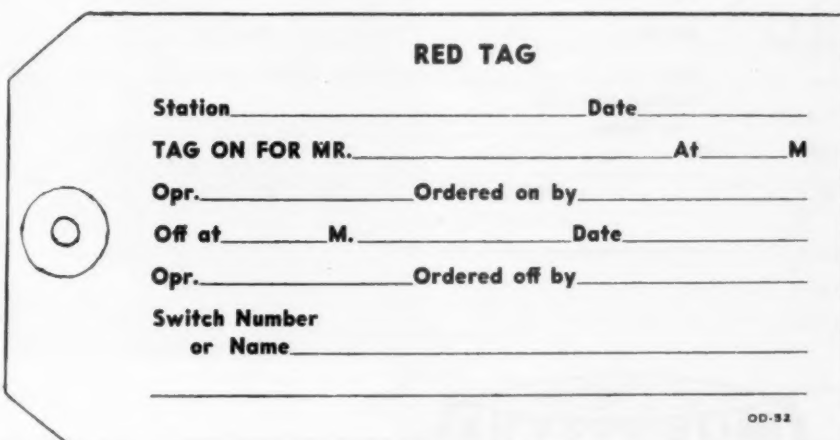
Blue Tag is for switches to indicate a live line which must remain so while the one man permitted to be working keeps his Blue Tag on it. Thus, any number of Red Tags may be attached, but only one Blue Tag. A Blue Tag indicates that all line or equipment are to be considered alive

MEN AT WORK

SAFETY FIRST

THIS TAG MUST NOT BE REMOVED OR SWITCH CLOSED UNTIL MAN HAVING SAME ATTACHED HAS CLEARED AND SYSTEM OPERATOR OR DISPATCHER HAS ORDERED ITS REMOVAL.

Red Tag—Front



RED TAG

Station__________ Date__________

TAG ON FOR MR.__________ At_____ M

Opr.__________ Ordered on by__________

Off at_____ M.__________ Date__________

Opr.__________ Ordered off by__________

Switch Number
or Name__________

OD-32

Red Tag—Back

and may have many times the normal voltage, for instance, during insulation tests. It is hoped that these reproductions may serve as guides for plant managers who may have similar tags made for the use and protection of workmen and equipment.

(*Continued on page 18*)

(*Continued from page 17*)

SAFETY FIRST

THIS SWITCH IS TO BE CONSIDERED ALIVE AND MUST NOT BE OPERATED EXCEPT BY ORDER OF THE PERSON FOR WHOM THE TAG IS ATTACHED.

Blue Tag—Front

BLUE TAG

Station ____________ **Date** ____________

TAG ON FOR MR. ____________ **At** ______ **M.**

Opr. ____________ **Ordered on by** ____________

Off at ______ **M.** ____________ **Date** ____________

Opr. ____________ **Ordered off by** ____________

Switch Number or Name ____________

ONLY ONE AT A TIME TESTING

OD-53

Blue Tag—Back

(*Continued on page 20*)

(*Continued from page 18*)

"Soviet Water Pumps Cover Nazis With Ice" was a recent heading for a United Press report of the British radio announcing a new secret weapon in use by the Russians. It is a pump, driven by an electric motor, which squirts cold water upon Germans, who are quickly covered with ice in the sub-zero weather.

Max Levine, formerly Prof. in Charge, Dept. of Bacteriology, Iowa State College, Ames, Iowa, is now serving as a Major in the U.S. Army, stationed at the Laboratory, New Hospital, Ft. Sam Houston, Tex. Major (Prof.) Levine has two sons in the U.S. services and a third son is trained in the reserves.

Malcolm Pirnie, Consulting Engineer of New York, was elected President of the American Institute of Consulting Engineers at the Institute's council meeting in New York on January 20. Mr. Pirnie has long been active in A.W.W.A. affairs, having received the Diven Medal in 1931, served two terms as a Director, and been President in 1934. He is currently serving as Chairman of the Committee on Water Works Practice which is in charge of all technical A.W.W.A. activities.

(*Continued on page 22*)

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Lewis S. Finch, Consulting Engineer of Indianapolis, Ind., is now Principal Assistant Engineer for the Indianapolis Water Co., a position left open by the death of Homer Rupard last June. Mr. Finch graduated from Purdue in 1921 and from 1925 to 1933 he was Chief Engineer for the Indiana State Board of Health. In 1933 he entered private practice. He was head of the Indiana Section of the A.W.W.A. in 1932, of the Central States Sewage Works Assn. in 1930 and of the Indiana Engineering Society in 1933.

Maintaining Public Relations During War Times.—Many water plants throughout the country have adopted the precautionary measure, during the present emergency, of barring all visitors from water treatment plants. Such policies directly affect educational groups such as high school classes, college classes, nurses, etc.

In order to maintain satisfactory public relations, it is suggested that water plant officials take advantage of movie films which describe water treatment processes in general. One such film entitled "Behind the Water Tap" is made available, without charge, to any water works official. This movie is on 16 mm. colored silent film and is shipped on three 400-ft. reels. Time of showing is about 35 min.

(*Continued on page 26*)

PROFESSIONAL SERVICES

(*Continued from page 22*)

In requesting the loan of the film, it is desirable to specify alternative dates since requests will be handled in the order in which they are received. Write to: West Virginia Pulp and Paper Co., Industrial Chemical Sales Div., 748 Public Ledger Bldg., Philadelphia, Pa.

The Mathieson Alkali Works, Inc., producer of liquid chlorine and other chemicals used in the purification of water and the disinfection of sewage, is observing its fiftieth anniversary. The company received its charter in Virginia in 1892.

With plants in Saltville, Va., Niagara Falls, N.Y., and Lake Charles, La., Mathieson is one of the major producers of alkalies, chlorine, synthetic ammonia, and numerous other products. At present, all three plants have been geared to maximum production to supply chemicals vitally necessary to our all-out war effort.

Half a century ago, all of the bleaching powder and most of the alkali consumed in this country were still imported from England, and the prejudice in favor of the imported products was strong. To insure a product equally as good, construction and initial operation of the new company's plant were entrusted to a retired English alkali manufacturer, Neil Mathieson. He sent a son, Thomas T. Mathieson, to this country, and under the

(*Continued on page 28*)

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latter's supervision a plant was built at Saltville, Va., where there are huge and historic salt deposits.

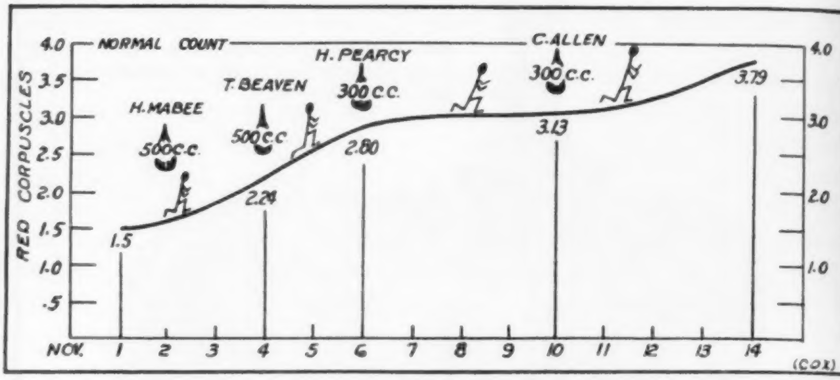
About that same time, Mathieson obtained control, in this country, of the Castner electrolytic cell for the manufacture of extremely pure caustic soda and chlorine, and to obtain cheap power, a plant was constructed at Niagara Falls, N.Y. Production began in this plant late in 1896.

Other notable Mathieson accomplishments include the commercial production of synthetic ammonia in 1923; the development of a true calcium hypochlorite as a new chlorine carrier in 1928; the development of sodium chlorite as an improved bleaching agent for textiles, paper, flour and other materials in 1939; fused alkalies in briquet form for a variety of uses; synthetic salt cake to replace foreign supplies for kraft paper manufacturers; exceptionally pure dry ice and carbonic gas from carbon dioxide, obtained as a by-product from the ammonia soda process at Saltville; especially designed containers for the shipment of liquid chlorine; and the distribution of caustic soda in liquid form in tank cars and in a specially designed sea-going tanker, plying between Lake Charles and Norfolk, Va., where Mathieson operates a liquid caustic storage terminal.

(*Continued on page 30*)

(*Continued from page 28*)

When W. C. Mabee, Chief Engineer of the Indianapolis Water Co., was seriously ill recently and received four blood transfusions, he visualized his trip to recovery as something like a water pumpage chart, as shown herewith. He entered the hospital with a red corpuscle count of one and



W. C. Mabee's Pumpage Chart

a half millions; the chart tells the rest. Mr. Mabee received blood from his son and from three employees of the Indianapolis Water Co., who were quickly chosen from the records of a blood type survey which has been made of all employees.

A new service for seamless-tube buyers has been instituted by the Seamless Steel Tube Institute, Gulf Bldg., Pittsburgh. The move is planned to benefit two classes of tube purchasers: those who have bought certain grades of tubing in peacetime but may be unfamiliar with other or special grades and types required for war equipment; and those who are searching for tubing for the first time and must find out about the specialties which may be made by only two or three mills.

(*Continued on page 32*)

(*Continued from page 30*)

Protection against bombing, sabotage and weather are covered in the "News Letter" and other recent publications of the Pump Division of Byron Jackson Co., P.O. Box 1307 Arcade Sta., Los Angeles. "As war clouds become thicker," said the September 15, 1941 Byron Jackson's "News Letter," "a great deal more attention is being given by the United States Army authorities and experienced engineers throughout the country to protect and maintain water supply under war conditions." Then in detail are set forth the possibilities of attaining protection with submersible pumping units.

Other recent descriptions of interest to water works men cover automatic operation, fire protection supply and installations for operation in cold climates.

To choose from among the 43 paint, enamel and varnish products of the American-Marietta Co., two charts are available, giving in 51 divisions in one chart all types of surfaces and giving in the other chart the properties of a specific paint which will meet the surface's needs. For the charts, called the "Valdura Paint Selector," write to: American-Marietta Co., 43 East Ohio St., Chicago.

(*Continued on page 34*)

(*Continued from page 32*)

George B. Beitzel has been made Vice-President in Charge of Sales for the Pennsylvania Salt Mfg. Co. of Philadelphia. Mr. Beitzel was educated in the public schools of Philadelphia and in the University of Pennsylvania. He served in the U. S. Army in World War I and after the war spent a number of years with John T. Lewis & Bros. Company, paint manufacturers. He came to the Pennsylvania Salt Mfg. Co. twelve years ago.

"Thermodynamics of Boiler Feeding" is the first prize winning essay of the First Annual Engineering Essay Contest of the Hydraulic Institute. Some of the specific items covered are: a description of feed cycles in general, discussion of pumping power and mechanical problems with relation to feedwater temperature, analysis of temperature rise in boiler feed pumps, thermodynamic efficiency of boiler feed pumps, disposal of bypass and leak-offs, and discussion of minimum permissible capacities. Eighteen diagrams illustrate these points. Copies may be secured by sending 50 cents for each copy wanted to the Hydraulic Institute, 90 West St., New York, N.Y.

(*Continued on page 36*)


HERSEY

(*Continued from page 34*)

Pomona Pump Co., manufacturer of vertical pumps, has announced the purchase of the Westco Pump Division of Micro-Westco, Inc., Bettendorf, Iowa.

The newly acquired business will be operated as Pomona Pump Co., Westco Division, at 2621 Locust Street, St. Louis, Mo., and manufacture continued from the St. Louis plant of the Pomona Pump Co. Management and key personnel of Westco will be transferred to St. Louis to continue the manufacture and distribution of Westco pumps through the same national organization which has been built up by Westco over the past sixteen years.

Addition of the Westco turbine type pump for industrial and marine application, also boiler feed and condensation units, side suction centrifugals, complete water systems, line and cellar drainers, rounds out the line of Pomona deep well, low lift, industrial, marine and municipal pumps. During the last few years Pomona has added the Little Chief turbine pump and also Pomona deep and shallow well jets.

"WPA Overhauling All Water Control Valves in Queens" is a release forwarded by Earl Minderman, Director of the Division of Information, Work Projects Administration, Washington, D.C. It follows, in full:

"Twenty-eight thousand Queens valves controlling the flow of 93,000,000 gal. of water daily to 1,300,000 persons in the borough, are being overhauled by the Work Projects Administration in New York City.

"The work has been undertaken at the request of the Dept. of Water Supply, Gas and Electricity to insure quick and efficient valve control, both for shutting off water and rerouting it through other mains, which would be necessary in case of damage to mains by bombs or other causes. Manipulation of the various valves may prevent waste of water, interruption in service, and lowering of water pressure when it is most needed for fire-fighting purposes.

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"All valves in Queens which are a part of the city's water supply system will be gone over by the WPA forces. Territory to be covered includes all of the North Shore and some central Queens communities, Woodhaven and Cross Bay Boulevards and the Rockaway peninsula.

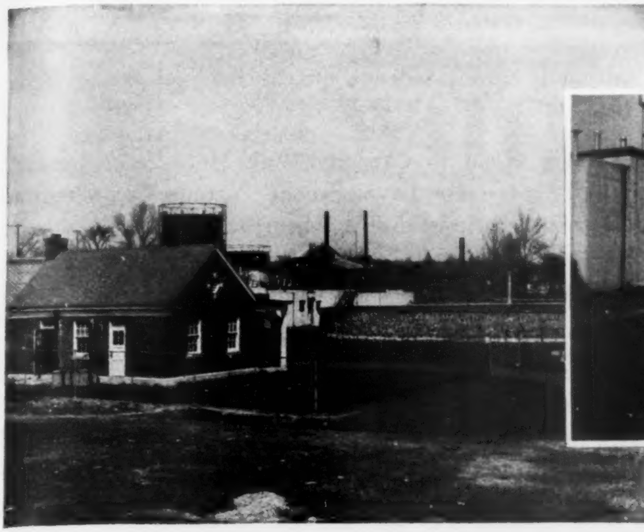
"*In some cases valve boxes have been completely covered through the years by washing down of mud and other causes. These are being located quickly by reference to new water supply maps just completed by WPA under another project.*" (Italics Ours).

From the "Municipal Finance News Letter" of January 16:

"Sales of Scrap—Alert city officials are both patriotic and businesslike when they take steps to collect and sell certain waste and scrap materials which may accumulate in the various municipal departments. Such sales divert needed materials back into industrial channels for reclamation and war use; at the same time the city may realize some miscellaneous revenue. Old materials which are needed for reclamation include: burlap, scrap metals, rubber, old rags, waste paper, and tin cans. . . . Some 12,000 tons of tin will be recovered from treatment of discarded tin cans, OPM has announced."

"Conservation of Paper—Suggestions offered recently which will help reduce paper consumption are worth passing on to all municipal offices: write briefly, use both sides of second sheets, use postal cards rather than letters where possible, order short forms for short subjects, use smaller memo pads and envelopes, and save incoming containers and large envelopes for re-use. Further savings may be secured by placing

(Continued on page 40)



G. L. Palmer,
Superintendent

Stroudsburg, Pa. USES MATHIESON CHLORINE & HTH *for sewage treatment*

"(And) . . . we are completely satisfied," says Gilbert L. Palmer, Superintendent

● Mathieson Chlorine and HTH have been used in this modern sewage treatment plant at Stroudsburg, Pa. since the plant was first put in operation in 1937. Both products have been used continuously since that time . . . rendering "completely satisfactory" service. Mathieson Chlorine for post-chlorination and HTH in the dosing chamber for the elimination of filter flies—also for regular dosing of the beds.

Satisfactory service is an old story to Mathieson Chlorine and HTH. Stroudsburg is only one of hundreds of cities and towns that find Mathieson sanitation service both dependable and efficient. In Mathieson Chlorine you get *pure* chlorine and prompt delivery in well kept, trouble-free containers. HTH, also, in addition to its use on everyday sanitation jobs, should be kept on hand for quick emergency service requiring a mobile, high-test chlorine carrier.

Write us for full information on Mathieson Chlorine and HTH.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 100-lb. drums.

THE Mathieson Alkali Works (INC)
60 EAST 42ND STREET NEW YORK N.Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

(*Continued from page 38*)

carbon copies of outgoing correspondence on the back of letters being answered."

"Relation of Suction Head to Capacity With Hot Water Pumps" is a leaflet distributed by the De Laval Steam Turbine Co., Trenton, N.J. It shows how the performance of a pump handling hot water at various temperatures may be correctly deduced from the characteristic curves of the same pump when handling cold water at corresponding suction lifts.

Anyone who has experience with underground corrosion to relate is a candidate for participation in the Soil Corrosion Conference to be held late in 1942 or early in 1943. K. H. Logan, Chief of the Underground Corrosion Section of the National Bureau of Standards has supplied the information given herewith. Further details may be had directly from him.

The winning of the war is, of course, our first objective and nothing must interfere with our efforts in this direction. There are, however, many corrosion problems intimately associated with national defense

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and with the problems of recovery which is to follow. It seems advisable, therefore, to afford those who can do so an opportunity to assemble and assist each other by discussing underground corrosion.

Those who have not participated in previsou Soil Corrosion Conferences will wish to know that attendance is limited to authors of papers and members of their companies. Anyone may attend who presents a paper containing unpublished data related to underground corrosion or its prevention. Sales promotion papers are not wanted. The contributions need not be papers suitable for publication but they should contain specific data bearing on corrosion phenomena. Each participant in the Conference must submit his paper six weeks prior to the conference and in sufficient number to supply each other participant with a copy. The number of participants has ranged from 36 to 78 in the past.

An unusual type of well was found by Otto Blue of Indianapolis, who reported it in the Indianapolis Water Company's "Water Lines." It is in Westmoreland, Tenn., and consists of a 6-inch casing, 60 ft. deep. A long bucket is lowered into the casing, a valve in its bottom closing when the bucket is raised, thus containing within the bucket 2 gal. of water. A rod fastened to this valve lifts it to release the water into a container.

(*Continued from page viii*)

JOHNSON, ERIC F. Research Asst., American Water Works Assn., 22 E. 40th St., New York, N.Y.
KAUFMAN, R. A. Mgr., Port Chester Water Works, Inc., 12 Havemeyer Place Greenwich, Conn.
KINNEAR, J. MILTON. Asst. Civ. Engr., Bureau of Water Supply, 2823 Overland Ave., Baltimore, Md.
LAUSTER, KENNETH C. Assoc. San. Engr., State Dept. of Health, Bismarck, N.D.
LEE, W. H., JR. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W. Drawer 1734, Atlanta, Ga.
LELAND, BENN J. San. Engr., Cook County Public Health Unit, 737 S. Wolcott Ave., Chicago, Ill.
LEWANDA, WILLIAM. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W., Drawer 1734, Atlanta, Ga.
MCQUILKIN, F. R. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W., Drawer 1734, Atlanta, Ga.
MILLER, LAVERN A. Chief Engr., Miller Eng. Service, 719 E. Main St., Streator, Ill.
MURRAY, JOSEPH F. Engr. of Special Arrangements, Div. of Water, 101 City Hall Annex, Newark, N.J.
PINKNEY, MARK E. Water Comr., Webster Water Dept., Webster, N.Y.
PLACE, CLYDE R. Cons. Engr., 420 Lexington Ave., New York, N.Y.
ROBIE, KENNETH W. Asst. Supt., Brookline Water Dept., 20 Copley St., Brookline, Mass.
RODRIGUEZ P., JESUS A. Designing Engr., Ministerio de Obras Publicas, Avilanes a Mirado No. 59, Caracas, Venezuela, South America
ROGERS, EDWARD J. Pres. & Gen. Mgr., Layne-Northwest Co., 709 N. 11th St., Milwaukee, Wis.
ROTHE, H. S. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W., Drawer 1734, Atlanta, Ga.

(*Continued on page 46*)

(Continued from page 44)

SCHAMBERGER, KARL H. Asst. Civ. Engr., Bureau of Water Supply, 1314 Lakeside Ave., Baltimore, Md.

SCHUDEL, GUSTAV W. Asst. Civ. Engr., Bureau of Water Supply, 719 Lyndhurst St., Baltimore, Md.

SERVIS, J. D. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W., Drawer 1734, Atlanta, Ga.

SIMMERMACHER, S. C. Chief of Power Plants, Div. of Water & Heat, 616 Auditorium Bldg., Cleveland, Ohio

STEWARD, W. R. Supt., White County Water Co., Searcy, Ark.

STOTHOFF, W. LUTHER. Pres., W. Stothoff Co., Inc., Flemington, N.J.

SULLIVAN, J. R. Mgr., Public Utilities Com., 524 Dundas St., Woodstock, Ont., Canada

TRAVER, WARD B. Bottlers' Service Dept., The Coca-Cola Co., 310 North Ave., N.W., Drawer 1734, Atlanta, Ga.

VILLA, MIGUEL. Cons. Engr., Prof., Univ. of Havana, Manzana de Gomez, 334, Havana, Cuba

WATFORD, TROY ELLIS. City Engr. & Supt. of Water Works, Box 661, City Hall, Gadsden, Ala.

WILLETTS, J. V. Supt., City Water Works, 1604 Main St., Elwood, Ind.

WINDFELDER, WALTER. Chief, Div. of Water Assessments and Collection, Milwaukee Water Works, City Hall, Milwaukee, Wis.

Corporate Members

DALTON FIRE DIST. Kenneth E. Russell, Supt., 399½ Main St., Dalton, Mass.

HAVRE WATER DEPT. G. A. Patterson, City Clerk, City Hall, Havre, Mont.

NATIONAL AUTOMATIC SPRINKLER ASSN. F. A. Wogel, Secy.-Treas., 205 E. 42nd St., New York, N.Y.

UTAH STATE DEPT. OF HEALTH. Div. of Public Health Eng. & Sanitation, Lynn M. Thatcher, Director, 130 State Capitol, Salt Lake City, Utah

Junior Members

DONG, YEN H. Student, 127 W. 52nd St., New York, N.Y.

FARNSWORTH, GEO. L., JR. Dist. San. Engr., Illinois Dept. of Public Health, 111 Dean St., Woodstock, Ill.

Reinstatements—Active Members

JOHNSON, JESS B. Supt. of Utilities, Sturgeon Bay, City Hall Annex Bldg., Sturgeon Bay, Wis.

Deaths—Active Members

DRUBECK, MAURICE A. Filtration Designer, Div. of Water Purif., City of Chicago, 1006 City Hall, Chicago, Ill.

PAULETTE, R. J. Paulette & Wilson, Cons. Engrs., 1006 Kansas Ave., Topeka, Kan.

PRATT, ARTHUR H. Cons. Engr., 24 Commerce St. Newark, N.J.

Transfers Between Sections

BRISBANE, EUGENE C. From Four States to California
CRUM, E. H. From Illinois to Indiana
LUTZ, HOWLAND C. From Florida to Four States
MCGUIRE, ORLA E. From Michigan to North Carolina
PAULUS, HAROLD J. From Missouri Valley to Southwest
RHYNUS, C. P. From Florida to New York
ZENTNER, E. T. From New York to Southwest

NEWS OF THE FIELD

Mutual aid among water works moves forward. The states along the Atlantic and the Pacific moved ahead first simply because everyone proceeds upon the assumption that attacks, when they come, will touch the coastal states first. But now the great central valley of the Mississippi is moving into line to organize its water works men into "self-help" groups.

In one state, it was rumored that the inventories of available repair material might be seized upon by military authorities and the supplies commandeered by the Army or some other Federal agency. This rumor was based upon some supposed happenings in New York. Here is what Earl Devendorf had to say when the story came to him.

"At the start of our Mutual Aid Plan some local water authorities did entertain such fears and it was necessary to give them assurance that the inventories would be held in confidence by Zone Coordinators. But to my knowledge there has been no case in New York State where military authorities have attempted to commandeer water works materials or supplies. These fears have pretty well melted away in New York since about 90 per cent of our local water authorities have submitted inventories.

"I think that the fears that these inventories might fall into hands of military authorities and be used by them as a basis for commandeering materials are without much point. This is not to say of course that the Army might not some time commandeer anything that it needs because we are at war and it has the authority to do this.

"If it ever comes to the point where the Army decides to draft water works materials or used automobiles or any other equipment which it needs, there is no question in my mind but what all citizens including local water authorities will have to contribute. But this eventuality as I see it is in no way related to the inventories which local water authorities have filed under the Mutual Aid Plan."

All the above is well said. Just one idea can be added. No Federal agency has manifested any tendency to minimize the first line importance of public water supply. Water works are getting adequate priority ratings to meet their real needs. No one yet has been less than cooperative when he had a fair presentation of the requirements of the field.

That goes for mutual aid inventories as well as the other records water works are called upon to produce.

So let's make the best use of a fine and sensible idea—the Mutual Aid Plan, and *keep the water flowing come hell or highwater!*

(*Continued on page 2*)

(*Continued from page 1*)

To conserve the supply and direct the distribution of Agar, General Preference Order No. M-96 has been issued, from which the following section is quoted:

"(c) Restrictions on the sale or use of Agar. No person may buy any Agar the sale of which is forbidden by this Order. Notwithstanding anything in Priorities Regulation No. 1, as amended, to the contrary no person having in his possession or under his control on the date of this Order (Feb. 9, 1942), or subsequently acquiring, any Agar, shall use or sell any such Agar, except as specifically ordered by the Director of Industry Operations, or for incorporation into Bacteriological Media, *provided* that any person seeking to purchase Agar for such incorporation shall furnish to the seller in duplicate a statement in writing, manually signed by a responsible official, certifying that the Agar is to be so used. Such statement shall be substantially in the following form:

"I require .... pounds of Agar for incorporation into bacteriological media. I have .... pounds in my possession or under my control, leaving a shortage of, ... pounds which I must fill by purchase.

Name ....

By ....

A copy of such statement shall be filed by the seller with the War Production Board. Such statement shall constitute a representation to the War Production Board and the seller of the facts stated therein. The seller shall be entitled to rely on such representation unless he knows or has reason to believe it to be false. Any person making such a representation may use such Agar only for the purpose specified."

(*Continued on page 4*)

James S. Dunwoody, Superintendent, Water Dept., Erie, Pa., died of a heart attack on March 21, at the age of 51.

Mr. Dunwoody was born in Waterford, N. Y., and attended Rensselaer Polytechnic Institute. It was after Erie's 1911 typhoid fever epidemic and upon the suggestion of Dr. W. M. Mason, at that time one of the country's leading sanitary engineers, that Mr. Dunwoody was obtained for service in the chemistry department of the Water Bureau. In 1919 he was made Superintendent by the then Board of Water Commissioners. He had been very active in the affairs of the Western Pennsylvania Section, had served as a Director on the A.W.W.A. Board in 1933–35, and had been an Active Member since 1913. He was a former President and a District Governor of Rotary International and was a member of the Erie Engineering Society.

(*Continued from page 2*)

Aluminum paint was placed under a complete allocation system on March 11 by the Director of Industry Operations. Order M-1-g requires specific authorization for the manufacture, use or sale of aluminum pigment and aluminum paint, except in retail distribution to the ultimate consumer.

Form PD-312 is provided for applications for use of aluminum pigment or paint, and manufacturers and jobbers are required to report stocks on hand monthly on Form PD-313. These forms are available for distribution through field offices or from WPB in Washington.

Wyman R. Stone, who was recently with the State Department of Health of Connecticut, has gone to Ecuador as Sanitary Engineer with the field staff organized by Dr. George C. Dunham, formerly of the U. S. Army Medical Corps and a specialist in tropical medicine. Mr. Stone, who was graduated from the Harvard Engineering School as a Civil Engineer in 1931 and received his Masters Degree in Sanitary Engineering in 1933, has spent three years in Bogata, Colombia, working on water systems, and has also served for two years with the Venezuelan Ministry of Public Works designing filter plants for various Venezuelan cities.

The sanitary engineering activities within the Office of Civilian Defense are of vital interest to the water works superintendent or manager in several important ways.

Under the Medical Division of OCD is established the Sanitary Engineering Section with its activities directed by R. E. Tarbett, Senior Sanitary Engineer of the U.S. Public Health Service. The personnel serving under Mr. Tarbett is composed of commissioned officers of the U.S. Public Health Service. They are stationed throughout the Regional Civilian Defense Areas for the purpose of acting in an advisory capacity and collaborating with State Directors of Civilian Defense through their State Water Co-ordinators or similar officials.

(*Continued on page 6*)

Edward T. Fishwick, Vice-President and Director of the Worthington Pump and Machinery Corp., died on March 15 at his home in Glen Ridge, N. J. He had been with the Worthington organization for 49 years, having started with the concern at its works at Cincinnati, where he was born. He was also President and a Director of the Worthington-Gamon Meter Co.

Mr. Fishwick was an Active Member of the A.W.W.A. and at one time served as President of the Water Works Manufacturers Assn. He was a Director of the New Jersey State Chamber of Commerce and was formerly head of the Diesel Engine Manufacturers Assn.

(*Continued from page 4*)

All the Sanitary Engineers in the Regional Civilian Defense Areas also serve as deputies designated by Mr. Tarbett who in this instance functions under the Facility Security Program of the U.S. Public Health Service. This portion of the activities has to do with preventing sabotage, etc.

Major J. H. Brewster, who has long been active in public health engineering work both in Indiana and New York, is stationed in the office for the First and Second Regional Civilian Defense Areas (New England, New York and New Jersey).

Covering the Third Area and part of the Fifth Area (chiefly Pennsylvania, Maryland, Virginia, West Virginia and Ohio) is G. E. McCallum. Covering the remainder of the Third Area and all of the Sixth and Seventh Areas (the north central part of U.S.) is William H. Cary Jr. whose appointment was recently announced. Since being graduated from the University of Michigan College of Engineering in 1925, he has served as Junior Engineer with the Chicago Sanitary Dist., as Assistant Engineer with the Detroit Dept. of Health, as Analyst and Public Health Engineer with the U.S. Public Health Service, and as Assistant Engineer with the Michigan State Dept. of Health.

(*Continued on page 8*)

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The most recent appointment is David W. Evans who will cover southeastern and Gulf parts of U.S., the Fourth and Eighth Areas. Mr. Evans has worked on stream pollution survey work in West Virginia, has worked for a coal mining concern at Sharon, Pa., and has been an Assistant District Engineer for the Pennsylvania State Health Dept. Most recently he was Senior Sanitary Engineer with the Farm Security Administration.

In the Ninth Area is G. E. Arnold whose appointment was announced in the January JOURNAL News of the Field.

This organization, functioning as the Sanitary Engineering Section of OCD, is currently concerned with several water works factors in the war and defense effort. Apart from the civilian defense phase, the War Department holds the water superintendent or manager responsible for supplying water to war industries. This should lead the water superintendent to take the initiative to make certain his ability to supply water under emergency conditions.

The Sanitary Engineering Section of OCD is also seeking through the State Water Co-ordinators and the State Health Departments to get local sewage departments to develop repair crews. Inasmuch as sewers, once they are laid, ordinarily get little care, there are few trained repair men in

(*Continued on page 10*)

(*Continued from page 8*)

sewage departments; therefore it has been suggested that water departments as such, or local public works departments, must take steps to have available in case of bombing a large trained repair force which will not only take care of temporary water main repairs but also will effect repairs in sewers promptly so that regular water supply arrangements may be made. In some instances the Sanitary Engineering Section of OCD has asked a state health department to direct municipalities to expedite definite plans for adequate sewer and water main repair crews.

The Sanitary Engineering Section is also actively interested in the plans of local Control Centers for notifying water, gas, sewer and public works departments of the locations of breaks in mains, etc. The planning is that there should be some one deputized and on duty 24 hours per day at the Control Center to see that the utility personnel is advised. The Sanitary Engineering Section is not concerned with whether the repair squads consist entirely of persons regularly employed by the city or utility. It is felt that additional workers for repair squads may be listed for emergency or temporary work by obtaining names from OCD files.

The Sanitary Engineering Section of OCD co-operates with state health departments through the offices of State Water Co-ordinators, in which offices a state health department official as a rule holds a major position. It's efforts are toward adequate provision for protection of health and, in the case of disaster, to promote restoration of public water supplies both for domestic and fire fighting purposes.

(*Continued on page 12*)

George W. Hawley, Deputy State Engineer, Division of Water Resources, Sacramento, Calif., died of a heart attack on March 17, after having been in ill health for some time. Mr. Hawley had been an Active Member of the A.W.W.A. since 1922 and had been active in the affairs of the California Section. He had been in charge of the supervision of dams in California for many years and will be remembered for his comprehensive paper on State Supervision of Dams in the November 1935 JOURNAL.

Abel Reynolds, Treasurer and General Manager of the New England Water, Light & Power Assoc., died on February 12 at his home in Providence, R. I. He was born in Providence in 1870 and was well known in the water works field, having served as the head of many water companies owned and operated by the New England Water, Light & Power Co. He had served for the past several years as Treasurer of the New England Water Works Assn. and had been an Active Member of the A.W.W.A. since 1929.

(Continued from page 10)

That water works funds may properly be used for payment of expenses of A.W.W.A. Membership is amply borne out by the reply of Otto K. Jensen, Indiana State Board of Accounts, to the inquiry of Herman Horstman, Secretary-Treasurer of the A.W.W.A. Indiana Section. Throughout the A.W.W.A. Membership there are many instances of this valid practice which Members may well describe carefully to superintendents of small plants not now represented in the A.W.W.A.

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INDIANA SECTION
AMERICAN WATER WORKS ASSOCIATION

INDIANAPOLIS

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P. W. REED, Indianapolis
RALPH A. HOOT, Fort Wayne
J. C. VAUGHN, Hammond
LAWRENCE GUTSCH, Washington
GLEN J. GARMAN, Lafayette

January 12, 1942

Mr. Otto Jensen, Chief Examiner
State Board of Accounts
State House
Indianapolis, Indiana

Dear Mr. Jensen:

The Indiana Section of American Water Works Association is endeavoring to include in their membership the water operating officials of small municipal water properties. Our Membership Committee has indicated that on a number of occasions they have been unable to secure approval from the town boards, having control of the water utility, in approving a voucher for their membership due to their understanding that such expenditures would not be an expense which would be approved by the State Board of Accounts.

The Executive Committee of the Indiana Section are of the firm belief that during the present emergency a membership in the American Water Works Association will be more than justified as it will keep all operators abreast of the developments in priorities and in emergency operation measures.

I will appreciate hearing from you relative to this matter and trust that the inclusion of this expense will be considered a justified expense.

Very truly yours,

Herman Horstman

Herman Horstman,
Secretary-Treasurer

HGH:ee

(Continued on page 13)

(Continued from page 12)

DEPARTMENT OF INSPECTION AND SUPERVISION
OF PUBLIC OFFICES
State Board of Accounts
INDIANAPOLIS

OTTO K. JENSEN, *State Examiner*
EDW. A. COOPER, *Deputy Examiner*
R. P. FREEMAN, *Deputy Examiner*

January 21st
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Mr. Herman Horstman,
Secretary-Treasurer, Indiana Section,
American Water Works Association,
506 Traction Terminal Bldg.,
Indianapolis, Indiana

Dear Mr. Horstman:

In reply to your inquiry in regard to Water Works operating officials holding membership in the Indiana Section of the American Water Works Association; we do not believe this department has raised any objection to the proper municipal water works officials being members of the Water Works Association and fees for such members being paid from Water Works Funds.

It would appear, however, in many cases that memberships are held by and fees paid for officials who have very little to do with the operation or accounting of municipal utility properties and are members only for the sake of membership and not for the benefits that may be derived. From this standpoint, we have discouraged wholesale memberships.

Superintendents or managers of small utilities should derive some benefit from the Association meetings; likewise, the accountants for these utilities should keep abreast of the changes and developments.

This department does not object to expense which is within the law, just and reasonable, and for the benefit of the public. In most cases, management, operation of properties, and accounting, could be represented by from one to three memberships.

Very truly yours,

Otto K. Jensen

State Examiner

OKJ/ms

(Continued on page 14)

(*Continued from page 13*)

James H. Henderlite has transferred from his position at Post Utilities, Fort Bragg, N.C., to the Filtration Plant at Richmond, Va. Mr. Henderlite also previously served as City Chemist at Gastonia, N.C.

Wesley W. Polk has been named Chief Engineer of the Illinois Division of Highways. He was formerly Commissioner of Public Works at Evanston, Ill., and before that was Superintendent of Water Works there. He has long been an Active Member of the A.W.W.A. and is currently serving as a Director of the American Public Works Assn.

"Standardization Activities of National Technical and Trade Organizations" is a recent book published by the National Bureau of Standards, U.S. Dept. of Commerce, and available from the Superintendent of Documents, Government Printing Office, Washington, D.C., for 75 cents per copy. This book will be of value to engineers, contractors, and others interested in finding out about specifications, recommended practices and information which may be available from the many technical organizations. The activities of the A.W.W.A. are covered in some detail.

(*Continued on page 16*)

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The Federal Power Commission has published a report on "Comparative Gas Rates." The Commission's report, covering 199 cities of more than 50,000 population, resulted from a Senate resolution directing that such a study be made. Lowest rates were of course where natural gas is used and highest rates were in sections of the country where only manufactured gas is distributed. A study of the document will reveal many inconsistencies of interest to utility men.

The A.W.W.A. headquarters office wishes to put together a complete file of all editions of "Standard Methods of Water and Sewage Analysis." Those needed are the second, third, fourth and fifth editions, published between 1905 and 1925. These are wanted to add to the valuable file of correspondence preceding the first edition of the work, which with the first typewritten draft for the first edition, is now in the A.W.W.A. office. Anyone wishing to sell such editions should write the A.W.W.A. directly.

"Bibliography on Public Health and Allied Subjects" is a 28-page booklet recently issued by the Book Service of the American Public Health

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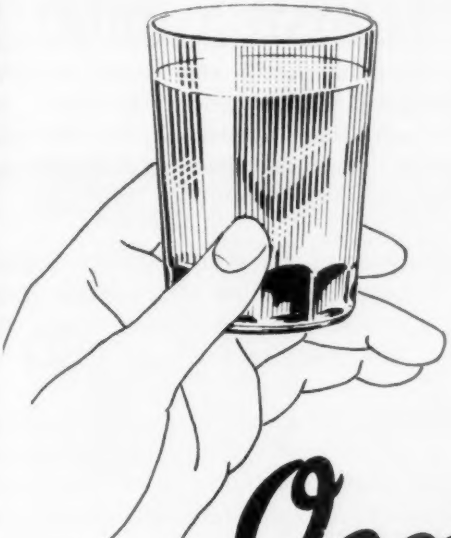

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Assn., 1790 Broadway, New York. Publications are indexed under the following subjects: preventive medicine and public health; laboratory; food and nutrition; vital statistics; public health engineering; industrial hygiene; mental hygiene; social hygiene and eugenics; tuberculosis; personal hygiene; child, maternity and school hygiene; health education; nursing; reference, medical history, etc.; miscellaneous; and American Public Health Assn. publications.

An examination for appointment as Assistant Sanitary Engineer in the Regular Commissioned Corps of the United States Public Health Service is scheduled to be held at Washington, D. C.; Cincinnati, Ohio; New Orleans, La.; Kansas City, Mo.; and San Francisco, Calif. 9 A.M. on May 11, 1942.

Candidates must be not less than 23 years nor more than 32 years of age on that date and must have had at least seven years of educational (exclusive of high school) and professional training, or experience equivalent thereto; and shall have graduated from a reputable professional school granting a degree in engineering (sanitary engineering course). In addition

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the applicant will be required to pass a satisfactory physical, academic and professional examination before a board of commissioned officers of the Regular Corps and will be required to submit to the board a recent photograph of himself, and his diploma from the professional school from which he was graduated or a certified copy thereof.

The written examination will comprise questions in (1) chemistry, (2) bacteriology and planktology; (3) mathematics; (4) physics; (5) hydraulics; (6) design and construction of sanitary projects; (7) heating, lighting and ventilation; (8) water and sewage treatment; (9) sanitary science and public health; (10) practical problems and laboratory demonstrations. The examination, physical, academic and professional will require approximately seven days for completion.

Commissioned officers are not appointed to any particular station, but to general service. They are subject to change of station as the exigencies of the Service may require and shall serve wherever assigned to duty.

Compensation, including allowance for quarters and subsistence, will be \$3158 and \$2699 for officers with and without dependents, respectively.

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Persons desirous of participating in this examination should address their application to the Surgeon General, U.S. Public Health Service, Washington, D. C., in their own handwriting requesting permission to appear before the board of examiners. The applicants should state their age, date and place of birth, present legal address, and whether a citizen of the United States, and the name of the professional school or college of which they are graduates, and furnish a recent photograph and at least two testimonials as to their professional and moral character. Applicants of foreign birth must furnish proof of United States citizenship. If natu-

(*Continued on page 26*)

Attend the A.W.W.A. Conference on Wartime Water Works Problems, at the Stevens Hotel, Chicago, June 21 to 25, 1942

PROFESSIONAL SERVICES

(*Continued from page 22*)

ralized, naturalization certificate should be presented with the application. Candidates born in the United States who pass the entire examination will be required to prove citizenship before being offered appointment.

Transportation expenses to and from and cost of maintenance at place of examination must be assumed by the candidate.

Conservation of Scholarly Journals is the aim of The American Library Association which created this last year the Committee on Aid to Libraries in War Areas, headed by John R. Russell, the Librarian of the University of Rochester. One of the most difficult tasks in library reconstruction after the first World War was that of completing foreign institutional sets of American scholarly, scientific, and technical periodicals. The attempt to avoid a duplication of that situation is now the concern of the Committee.

Many sets of journals will be broken by the financial inability of the institutions to renew subscriptions. As far as possible they will be completed from a stock of periodicals being purchased by the Committee. The Committee has already purchased from the A.W.W.A. a considerable number of complete sets of the JOURNAL for 1940 and 1941. Many sets

(*Continued on page 28*)

(Continued from page 26)

in foreign libraries will have been broken through mail difficulties and loss of shipments, while still other sets will have disappeared in the destruction of libraries. The size of the eventual demand is impossible to estimate, but requests received by the Committee already give evidence that it will be enormous.

With an imminent paper shortage attempts are being made to collect old periodicals for pulp. Fearing this possible reduction in the already limited supply of scholarly and scientific journals, the Committee hopes to enlist the co-operation of subscribers to this JOURNAL in preventing the sacrifice of this type of material to the pulp demand. It is scarcely necessary to mention the appreciation of foreign institutions and scholars for this activity.

On page 26 are listed numerous back issues of which the Association's stock is low. Selling the Association these numbers will help build up an inventory for future demands. Although the Association is prepared to buy back only certain numbers, it is suggested that Members either keep all extra back numbers or consult A.W.W.A. headquarters before converting any to waste paper.

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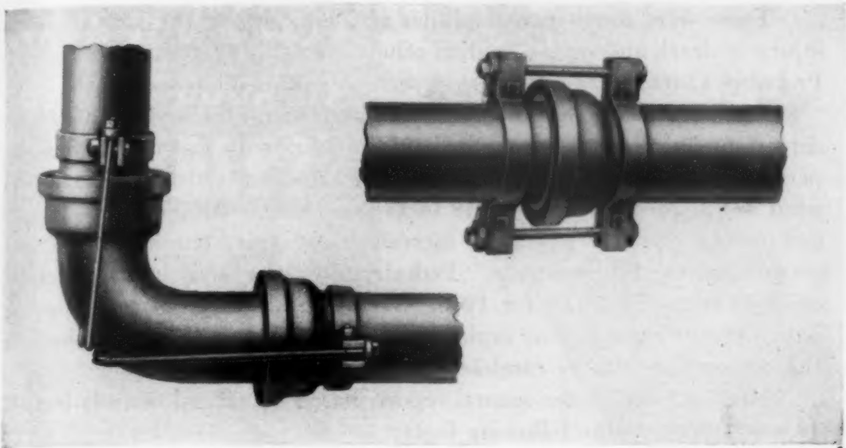
Robert Hall Craig, Consulting Engineer with offices in Harrisburg, Pa., and New York, N. Y., was recently appointed to the part-time position of a member of Pennsylvania's new Civil Service Commission.

"The Use Tax—Its History, Administration and Economic Effects" is No. 78 of the publications issued by the Public Administration Service, 1313 East 60th St., Chicago. Although this tax is in force in only 16 states and yields only a small percentage of the revenue in those states, it is a tax that may in the future be more widely adopted.

Last year, when the need of human energy and natural resources proved more desperately urgent than ever before, the American people proceeded to liquidate more of their number and to demolish more of their mechanical facilities than in any year since the introduction of the motor car, according to a new booklet entitled "The Wreckord" just issued by The Travelers Insurance Company.

The booklet is the twelfth in a series issued annually and presents a comprehensive analysis of the facts about accidents in which 40,000 persons were killed and almost a million and a half were injured in 1941. Both totals, it is pointed out, are the highest in the history of the automobile.

(*Continued on page 32*)



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There were more than a million accidents during the year involving injury or death and several million others involving property damage only. Probably 1,000 automobiles a week were demolished beyond repair.

Some of the increase in deaths and injuries can be laid at the door of drivers under 18 years of age and older drivers with less than a year's experience at the wheel, the analysis shows. Accidents also increased somewhat out of proportion in the 18 to 24 age group. Gasoline consumption and motor vehicle registration increased last year, but not in as great proportion as did accidents. Pedestrian deaths and injuries actually dropped from the totals for 1940. Weighing all these factors, the company's statisticians find no explanation for the abnormal record other than that drivers were more careless and reckless than ever before.

Highlights from the annual report, based on official records from the 48 states, include the following facts:

Exceeding the speed limit was responsible for almost 42 per cent of the fatalities. In no other year since the record has been kept has speed loomed so large as a factor in accidents.

Two out of every three persons killed met death as the result of some reckless or illegal action on the part of a driver.

More than 90 per cent of all vehicles involved in fatal and non-fatal accidents were in apparently good mechanical condition at the time of the crash.

More than 82 per cent of all fatal accidents occurred on dry roads and 87 per cent happened in clear weather.

(*Continued on page 34*)

Chlorine and ammonia cylinders should be kept in constant circulation—otherwise many users may have difficulty in obtaining adequate supplies. In spite of having to make heavier shipments than ever before, producers are now obtaining no new cylinders. All consumers should avoid carelessness about return of cylinders and should return cylinders just as quickly as possible.

(Continued from page 32)

A feature of this year's booklet is a quiz entitled "Off to Work You Go." It proves the folly of dawdling at home and then hurrying on the highway to make up for lost time and shows the "quizee" the exact hour he should get up in the morning in order to get to work safely and on time.

The insurance company will distribute more than two million copies of the booklet this year in the interest of highway safety. Single copies or quantities are available through the company or any of its representatives.

The 1942 edition of the Johns Manville Industrial Products Catalog has just been issued as Form GI-6A, available upon request from Johns-Manville, 22 East 40th St., New York. It is a 52-page book containing a great many illustrations and charts depicting the uses and characteristics of the many building and insulating materials produced by Johns-Manville. Transite Pipe, an asbestos-cement product for use as water and sewage lines, is covered in detail. Also covered are: refractory products and castables, roof and siding materials, industrial friction materials, electrical conduit and other electrical supplies, packings and gaskets, flooring and movable partitions.

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(*Continued from page 34*)

International Filter Co., Chicago, has changed its corporate name to "INFILCO Incorporated." Organized 48 years ago, during the pioneering age of water purification, Infilco's early activities were in the design and development of filters and filter plant equipment. Thirty years ago the company began the manufacture of water softeners and other water conditioning equipment. Today, with its products including sewage treatment equipment as well as a wide range of water conditioning equipment, the company's officials considered that the company should have a name of broader scope. For the past decade the name "Infilco" has been used to identify the company's rate of flow controllers, gages, chemical feeders, aerators, recarbonators, coagulators, clarifiers, etc.

The Mathieson Alkali Works, Inc., and the Defense Plants Corp. are beginning work on a new plant for the production of metallic magnesium and chlorine. The plant, which will be located at Lake Charles, La., and will cost approximately $22,500,000, will be owned by the Defense Plants Corp. It will be operated by Mathieson and will produce about 36,000,000 lb. of magnesium a year by a process developed by Mathieson.

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This process differs from other processes for making magnesium electrolytically, in that it does not consume chlorine but produces it in such concentration that it can be collected and liquefied. This is welcome news for the water works field at this time when anything that adds to chlorine output is of interst.

The magnesium produced by the Mathieson process is obtained from dolomite, a rock resembling limestone and consisting of calcium-magnesium carbonate, which will be shipped from nearby quarries. This material is calcined, using locally produced natural gas for the purpose, and the resulting oxides of calcium and magnesium are treated with calcium chloride, a product of the process by which soda ash is made at one of the Mathieson plants, also located at Lake Charles. The mass is then treated with carbon dioxide, obtained from the calcination of the dolomite, which converts the calcium into the insoluble carbonate, leaving magnesium chloride.

The magnesium chloride, after being concentrated, is electrolyzed in a new type of cell, which was independently developed by Mathieson in conjunction with The Consolidated Mining and Smelting Company, of Canada, Ltd. The products are metallic magnesium and chlorine, both of which are essential war materials.

R. W. Sparling, Box 3277 Terminal Annex, Los Angeles, has issued a series of charts which should be very convenient for persons concerned with the handling and measuring of liquids. These charts show, for instance, the weight, power and volume in water equivalents by cubic feet, gallons (U.S. and Imp.), pounds, acre feet, liters, etc.; also, equal rates

(Continued on page 40)

(*Continued from page 38*)

of flow by cubic feet per second (per hour and day also), and gallons, barrels and cubic meters per hour and day.

pH records from more than one point may now be obtained on a single chart with a recorder recently developed by the Cambridge Instrument Co., Inc. It provides a "before and after" picture for treatment phases in water and sewage plant operation and also for readily ascertaining the effect of the additions or mixing of other materials. Complete descriptions are available from the Cambridge Instrument Co., Inc., 3752 Grand Central Terminal, New York.

Emergency specifications for making windows for plants and factories without the use of metal have been developed by the Insulux Division of the Owens-Illinois Glass Co. Tests have been conducted using actual factory openings. The old sash was first removed, the masonry opening trimmed up and the sill painted with an asphalt emulsion especially developed by Insulux engineers for use with glass blocks. Wood chases were then erected at the jambs and head, after which expansion strips were

(*Continued on page 42*)

(*Continued from page 40*)

put in place. The glass blocks were then laid up in mortar; the panel edges were packed tight with oakum, then calked. Cleaning completed the job.

A booklet giving special working details for installing glass blocks without priority materials is available on request from the Owens-Illinois Glass Co., Insulux Products Div., Toledo, Ohio.

A new meter prover for volumetric testing of water meters has been placed on the market as the "Pittsburgh-National Water Meter Prover" by the Pittsburgh Equitable Meter Co. It is designed to test meters up to and including the 2-inch size. It has a cylindrical steel tank to which is attached a welded steel box holding the meter connections and a new type of rate of flow indicating device. The tank is divided into two compartments, one holding 100 U.S. gal. and the other 10 gal. Scales on the tank are adjustable for calibration and are marked to read in percentages of error at the 100-, 50-, 10-, 5-gallon, and the 10-, 5-, 1- and $\frac{1}{2}$-cu.ft. points. Two outlet pipes go to the measuring tank, one for each side of the tank. Between the outlet pipe and the outlet of the meter are two rate of flow

(*Continued on page 44*)

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indicators, one which reads $\frac{1}{20}$ gpm. to 15 gpm. and the other which reads up to 150 gpm. This equipment will accommodate two $\frac{5}{8}$-inch and two $\frac{3}{4}$-inch meters at one time and take single meters up to a length of 25 in.

"Bored for Cash" is a practical solution for an old problem contained in "The Percolator," organ of the The Chemist's Club, New York. Special items for local situations may be added to those contained in the original presentation, given in part below.

"A bore is one who talks about himself when you want to talk about yourself. There are many such. To capitalize on this human failing, it has been proposed that an organization be formed under the name of "Associated Sympathetic Listeners of the Round Table." Members of the organization will charge for sympathetic listening at the following rates, the time limit in each instance being five minutes (except as noted):

"How I made a birdie at golf	$ .25
"How I made an eagle	.30
"How I was in the rough but pitched out to win the hole.	.35

(*Continued on page 46*)

(Continued from page 44)

"How my 20-foot putt rolled around the rim of the cup but did not fall in .... .40
"Salesman's alibi or why I didn't make the sale .... .40
"About the slam I should have made at bridge but didn't .... .25
"That long run I made playing cowboy pool .... .45
"Questions I answered last night which "Information Please" couldn't (per question) .... .50
"The number of miles my car makes per gallon (per mile) .... .30
"The time it took me to drive from here to there (per landmark) .... .35
"About the judge who didn't know enough to accept the truth from me but who believed the opponent's expert .... .50
"My operation (per stitch) .... .25
"Repetition of same story about the same operation (per stitch) 1.00

"Surcharges: For extra patience, add 10 per cent; for yes-ing after each sentence, add 10 per cent; for stimulation by intelligent questioning, add 50 per cent."

(Continued from page viii)

Deaths—Active Members

CAMPBELL, H. A. Supt. of Public Activities, Cornwall, Ont., Canada
McGARIGLE, J. A. 137 Wellington St., W., Toronto, Ont., Canada

Transfers Between Sections

BEATTY, DICK. From Rocky Mountain to Pacific-Northwest
BRIGGS, RAYMOND J. From Rocky Mountain to Pacific Northwest
CHAMBERLAIN, L. H. From Illinois to New York
CRAMER, H. CABLE. From Kentucky-Tennessee to West Virginia
FRISK, PAUL W. From Foreign to Four States
IDAHO SURVEYING AND RATING BUREAU. From Rocky Mountain to Pacific-Northwest
JACKSON, T. B. From Rocky Mountain to Pacific-Northwest
JEROME WATER CO. From Rocky Mountain to Pacific-Northwest
LAWRENCE, R. E. From Missouri Valley to Four States
LEONARD, W. V. From Rocky Mountain to Pacific-Northwest
RAINEY, CLARENCE M. From Rocky Mountain to Pacific-Northwest
STANLEY, WILLIAM E. From Four States to Virginia

APPLICATION FOR MEMBERSHIP
IN THE
AMERICAN WATER WORKS ASSOCIATION
22 EAST 40th ST., NEW YORK

Date:..

.... hereby make application for
(I or We)

....
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of $.............................., one year's dues in advance.

Name..

Company or Department..

Title or Position...

Address...

....

If application is for Junior Membership, give date of birth..........................

If application is for Affiliate, state number of active water services in property where employed..

Nature of business or character of work (for office records)..........................

....

....

....

....

....

....

....

....

....

If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

....
Signature of Applicant.

Application obtained by:

....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

NEWS OF THE FIELD

Americans are getting an education these days. Attempts to understand the scarcity of tin, manganese and rubber are a course in economic geography. Let no one think that it is a free course. It is the most costly bit of education these United States have ever had.

Along with that we are all getting a course in metallurgy. With iron ore reserves that are the envy of our enemies, we are learning that scrap iron is essential to full production of steel. Even the cast-iron pipe, the valves and the hydrants contain their useful quota of scrap iron.

During the next few months, we must gather every pound of scrap metal that can be found—and get it into the hands of the iron and steel industry. Brass and copper scrap is also needed. This is no time to squawk about the scrap the Japs got. We need more than that and it's right here if we will arouse ourselves enough to gather it.

Every home, every farm, every water works, every factory has its "scatterment" of waste metal. Every state today has its metals conservation organization—a mighty important civilian activity. It's not civilian defense but civilian aid to the Army and Navy.

And mark you this, Mr. Water Works Man! If you want your Army and Navy to have the guns and the ships, if you want some pipe or a valve or two,—you will have to tie into the drive for scrap metal. Get rid of the old equipment you'll never use again—clean up your store houses—and start the flood of used metal on its way to war industry and munitions. Our scrapping soldiers and our scrap metal together can scrap the Axis.

(*Continued on page 2*)

Journal Readers! The A.W.W.A. is now co-operating with the Board of Economic Warfare, in submitting the entire Journal contents for censorship before printing—so if future Journals are a day or so late, *c'est la guerre.*

(*Continued from page 1*)

A State War Council and an Office of Civilian Protection are provided in legislation passed on April 14 by the New York State Legislature. Under the legislation, Governor Lehman will be head of the State War Council and the Office of Civilian Protection will be established under the War Council which will appoint a full-time salaried director. The bill provides for setting up non-salaried local city and county war councils. In the case of cities, a mayor may serve as head or may appoint a full-time, salaried or non-salaried local civilian protection director. The bill gives the State War Council almost unlimited powers to provide for civilian protection.

(*Continued on page 4*)

Arthur Newell Talbot, Professor Emeritus of Engineering at the University of Illinois, died in Chicago on April 3 after a short illness. He was 84.

Dr. Talbot was born in Cortland, Ill., and attended the University of Illinois, receiving his bachelor's degree in 1881. He spent four years in railroad engineering work in the West, then returned to the University of Illinois to teach. In 1890 he became Professor of Municipal and Sanitary Engineering. Early in his long career at the University he became actively interested in research and was a leader in obtaining facilities for research in hydraulics and the testing of construction materials. He helped found the University of Illinois Engineering Experiment Station, the first of its kind in the country. After becoming Professor Emeritus in 1926, he continued his research and also worked with advanced engineering students. In 1938 the new materials testing laboratory at the University was named after him—the first time a living person had been so honored at the University.

Talbot formulas and findings are used by engineers in many fields—fixing the areas of waterways, designing structures of reinforced concrete and other building materials, determining maximum rates of rainfall, and determining maximum stresses in railroad tracks. Dr. Talbot wrote more than 400 articles and bulletins. He served on the board which determined the Galveston causeway and also helped make a preliminary report in 1927 for the location of the San Francisco-Oakland Bay Bridge.

He had served as President of the American Society of Civil Engineers and of the American Society for Testing Materials. He had received honorary degrees from many universities and honorary membership in many organizations. Dr. Talbot had been an Active Member of the A.W.W.A. since 1894 and an Honorary Member since 1930.

(*Continued from page 2*)

Eligibility for tire certificates of automotive equipment used exclusively by public water works was defined as follows, as of April 3 by Thomas E. Harris, Assistant General Counsel of the Office of Price Administration, in response to an inquiry made by the Secretary of the A.W.W.A.

"Section 405 (f) (2) of the Revised Tire Rationing Regulations provides for the eligibility for new tires of trucks which are to transport materials and equipment for construction or for mechanical and highway maintenance or repair work. Eligibility of automotive equipment used in the maintenance of public water works may possibly be established under the above section.

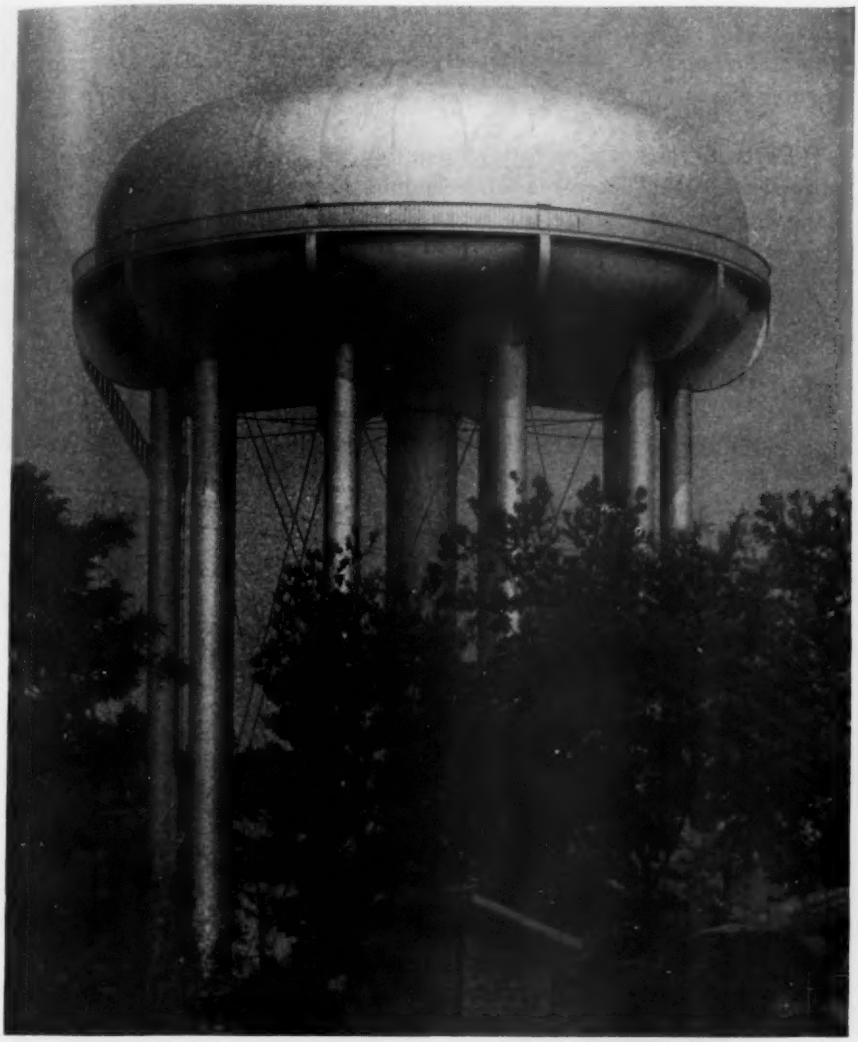
"The critical shortage in our supply of rubber has made it necessary to ration tires. The limited quota necessarily alloted to the Local Boards may make it impossible for the Local Boards to issue certificates even in cases where elibigility is established. Local Boards, with the duty of determining eligibility under the Regulations, are particularly well qualified to make such determinations in view of the fact that they have ready access to all the facts in each individual case, and in addition, have a thorough knowledge of local needs. We appreciate your recognition of the stern fact that rubber shortages must be met by concerted measures for conservation, and we are sure that you and the members of your Associa-

(*Continued on page 6*)

Joseph Jacobs, Consulting Engineer long associated with water, reclammation and power projects, died in Seattle, Wash., March 16. He was 72.

Mr. Jacobs was born in Leavenworth, Kan., but he had been a resident of Seattle for over 30 years. His long engineering experience included work for numerous railroads, the U. S. Geological Survey, and service as a major with the Corps of Engineers overseas in the first World War. In private practice, his activities ranged from designing a reclamation project in Porto Rico to investigation of the irrigation possibilities of the San Joaquin, American, Willamette, Lewis and Spokane Rivers in Washington; of the Rio Grande in Colorado; and of the Snake and Deschutes Rivers in Oregon. He participated in investigation of the Puget Sound-Grays Harbor-Columbia River canal project and did engineering work on the Grand Coulee and Cedar River dams, and on the Skagit River power project.

Mr. Jacobs had been an Active Member of the A.W.W.A. since 1920. He had just finished a term as Vice-President of the American Society of Civil Engineers and was a Past-President of the Pacific Northwest Society of Engineers and of the Washington Natural Resources Association.



(*Continued from page 4*)

tion will co-operate whole-heartedly in the program for the conservation of rubber."

Certain types of pipe fittings required for shipbuilding have been exempted from the operation of Schedule II to Limitation Order L-42 according to an amendment to the schedule, effective April 4, which alters the definition of pipe fittings to exclude hydraulic or high pressure types; cast or forged steel fittings; and brazed or soldered brass or bronze fittings, whether screwed or flanged at any outlet. The amendment was prepared after conferences with the Navy Department and the Bureau of Standards.

To curtail the use of certain types of asbestos, the War Production Board has issued the following order:

"(a) Paragraph (a) (3) of Section 1064.1 (Conservation Order No. M-79) is hereby amended to read as follows:

"In addition to the above limitations, unless otherwise specifically authorized by the Director of Industry Operations, after February 1, 1942 no person shall install eighty-five percent magnesia or other high

(*Continued on page 8*)

● Attend the A.W.W.A. Conference on Wartime Water Works Problems ●
at the Stevens Hotel, Chicago, June 21 to 25, 1942

(*Continued from page 6*)

temperature pipe covering except (1) in installations where temperatures of 200° F or over occur, or (2) in installations on ships."

Any old surveying gear to loan your Uncle? The War Department has announced that all surveying instruments in the stores of distributors have been purchased and that there is still a shortage, particularly of transits, levels and plane tables. The Corps of Engineers is ready to purchase, rent or borrow instruments from firms or individuals, with the present owners relinquishing them with or without a recapture clause, as they please. In charge of this procurement effort is Maj. R. L. Richardson, Office of the Chief of Engineers, Washington, D.C.

To promote the planning of post-war construction projects by local government units, the Public Work Reserve, established several months ago with WPA financing, has now been abolished, its activities separated from WPA, and in its stead has been set up a new unit known as the Local Public Works Programming Office. The new organization functions jointly under the Federal Works Administration and the Public Works Planning Division of the National Resources Planning Board.

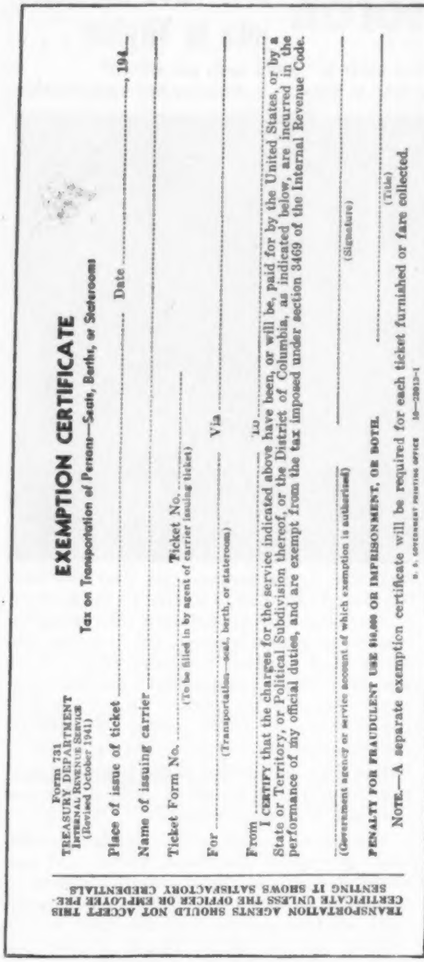
The Local Public Works Programming Office will urge local governments to plan six-year programs of local public works which may be undertaken, perhaps even at an early date, and with funds likely to be available from local sources. These local works reserve plans will first concentrate on projects to enhance the war effort. Additional projects will be planned as post-war activity. None of these local plans will necessarily depend upon any ultimately emerging federally financed program. The federal Programming Office will confine its activities to giving technical advice.

(*Continued on page 10*)

William Mitchell Reid, Superintendent of the Canton, Miss., Municipal Utilities for the past 19 years, died at the age of 46 on March 2 after an illness of several months.

Mr. Reid was born in Madison County, Miss., and attended the Canton schools. He was graduated as a Mechanical and Electrical Engineer from Mississippi Agricultural and Mechanical College. Before being elected to the position of Superintendent by the Canton Water and Light Commission, he taught mathematics and physics at the University of Pennsylvania for several years and also spent some time in engineering in California. At Canton he had had the job of doubling the capacity of the city's utility plant and distribution system. He had also supervised the construction of the city's gas line from Jackson, Miss.

(*Continued from page 8*)



Form 731
TREASURY DEPARTMENT
INTERNAL REVENUE SERVICE
(Revised October 1941)

EXEMPTION CERTIFICATE

Tax on Transportation of Persons—Seats, Berths, or Staterooms

Place of issue of ticket .... Date ...., 194...

Name of issuing carrier ....

Ticket Form No. .... Ticket No. ....
(To be filled in by agent of carrier issuing ticket)

For .... Via ....
(Transportation—seat, berth, or stateroom)

From .... to ....

I CERTIFY that the charges for the service indicated above have been, or will be, paid for by the United States, or by a State or Territory, or Political Subdivision thereof, or the District of Columbia, as indicated below, are incurred in the performance of my official duties, and are exempt from the tax imposed under section 3469 of the Internal Revenue Code.

.... (Government agency or service account of which exemption is authorized)

.... (Signature)

PENALTY FOR FRAUDULENT USE $10,000 OR IMPRISONMENT, OR BOTH.

.... (Title)

NOTE.—A separate exemption certificate will be required for each ticket furnished or fare collected.

U. S. GOVERNMENT PRINTING OFFICE 16—23013-1

TRANSPORTATION AGENTS SHOULD NOT ACCEPT THIS CERTIFICATE UNLESS THE OFFICER OR EMPLOYEE PRESENTING IT SHOWS SATISFACTORY CREDENTIALS

Sample of Form 731

Municipalities are exempt from the federal tax on railroad fares, etc. The new federal excise tax law imposed a tax of 5 per cent upon payments for transportation of persons by rail, bus, boat and airplane after October 10, 1941, but municipalities may obtain exemption by employing the Treasury Dept. Internal Revenue Service Form 731 (sample shown herewith), obtainable from the nearest Collector of Internal Revenue.

City employees should see that these forms are obtained and used to expedite their city's underwriting expenses to the A.W.W.A. Conference on Wartime Water Works Problems at Chicago, June 21–25, and to A.W.W.A. Section Meetings. Attendances this year have already indicated that water works men realize that such meetings are now more important than ever.

(*Continued on page 12*)

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To enhance the "Victory Garden" program in Los Angeles, the Los Angeles Bureau of Water Works and Supply has devised a plan to give a credit allowance, from the usual domestic rate, to householders irrigating "Victory Gardens." Consumers will state to the Water Bureau the area of their garden and, allowing 24 in. of irrigation water per season, they will receive a credit allowance of 10 cents off the domestic rate of 14.8 cents per 100 cu.ft. Meter readers in their regular rounds will check to see that a garden has been planted.

Emergency steel specifications work is being carried on by the American Society for Testing Materials with at least eleven committees now in operation. A.S.T.M. Committee TAC 11 on Tubular Steel Products has numerous active A.W.W.A. men on its roster. Reeves Newsom is serving in the division representing "Industrial Consumers and General Interests" in the main advisory committee which has six sections. The fifth and sixth sections have very considerable representations of A.W.W.A. members. Section V on Water Well Pipe has the following members for the "Industrial Consumers and General Interests"—J. A. Carr, J. C.

(Continued on page 14)

Bernal B. McReynolds, Water Superintendent for the Colorado Springs, Colo., Dept. of Public Utilities, died on April 2, 1942.

Mr. McReynolds was Colorado City's senior employee, having served the city for 48 years. He had been Water Superintendent since 1909. Mr. McReynolds had been an Active Member of the A.W.W.A. since 1914.

Albert Jacob Smalshaf, retired Superintendent of the Columbus, Ga., Water Works, died in that city on April 1, at the age of 51.

Mr. Smalshaf was born in Pottstown, Pa. He was graduated from Mercersburg Academy, Mercersburg, Pa., in 1910, and from Princeton University in 1914. He was a Lieutenant in the U.S. Public Health Service in the first World War, acting as a civil and sanitary engineer. He was sent by the Government to work with the Columbus Water Works during the war and in March 1919 was offered the position of Assistant Superintendent. He was later made Superintendent, a position which he resigned in September 1940, due to ill health. Mr. Smalshaf had been an Active Member of the A.W.W.A. since 1916.

(Continued from page 12)

Harding, W. W. Hurlbut, O. J. Muegge and Reeves Newsom; and for the "Producers"—W. O. Clinedinst, G. P. Hansen, S. H. Kilmer, J. W. Owings and L. H. Winkler. Section VI on Water Main Pipe has the following members for the "Industrial Consumers and General Interests"—F. A. Barbour, W. W. Brush, G. H. Fenkell, W. W. Hurlbut, Reeves Newsom, Malcolm Pirnie, F. M. Randlett, J. F. Skinner and T. H. Wiggin; and for the "Producers"—R. E. Barnard, W. H. Cates, H. M. Chadwick, A. A. Chambers, G. H. Garrett, H. S. Grassman, L. B. Grindlay, H. O. Hill, C. S. Patton and H. R. Redington.

Inter-connection of New Jersey's major public water supplies may now be effected by legislation recently passed by the New Jersey Legislature. Adopted explicitly as war emergency legislation, it will help guarantee adequate supply for war industries and fire fighting in possible emergencies. A total of $20,000 is provided for the State Water Policy Commission to prepare water supply plans for, and to supervise the construction of, inter-connections between water supply systems and to prepare other plans to assure a dependable water supply.

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A revolving fund of $300,000 is appropriated. The State Water Supply Commission will draw upon this fund when necessary to meet the State's share in the cost of any inter-connection. To this fund will be credited any sums resulting from assessments for benefits made pursuant to the Act. The Commission is given power to apply for, accept, and employ funds from the Federal government by adding such possible grants to the revolving fund.

Inter-connections to be made under this Act are limited to a maximum cost of $50,000, as it may be estimated by the Commission. The Commission has previously decided that the most important inter-connections are two in northern New Jersey and seven in the southern part of the state. There is no indication that the previously considered plan of constructing four large transmission mains at a cost of about $3,000,000 will be carried out in the near future.

The last clause of this legislation reads as follows:

"25. This act shall take effect immediately and shall be inoperative and of no effect one year after the date of the making of a treaty of peace or the last of treaties of peace concluding all of the present wars with the governments of Japan, Germany and Italy."

Inter-connections for 43 water supplies, both publicly and privately owned, in Nassau County, New York, are being planned as a war defense measure upon recommendation of the State Water Co-ordinator. The cost of the project has not been revealed, though it has been planned that the county and municipalities or private companies affected may bear it.

Authorization of a permanent inter-connection between two private electric utility lines has been made by the Federal Power Commission under Sec. 202(d) of the Federal Power Act. This Section of the law empowers the Commission to authorize connections for emergency use, without making the utilities subject to jurisdiction of the Commission because of the order. The utilities are the New Bedford Gas Co. and the

(Continued on page 18)

(*Continued from page 16*)

Montaup Electric Co. The inter-connection will assure adequate power for war industries in southeastern Massachusetts.

Robert W. Austin, formerly Hydraulic Engineer with the New York State Public Service Commission, is now commissioned as Captain in the U.S. Army, assigned to the Production and Procurement Division of the Chemical Warfare Service, with headquarters in Washington, D.C.

Wendell R. LaDue, Chief Engineer and Superintendent of the Akron, Ohio, Bureau of Water Supply, in April was given the job of supervising Akron's Division of Sewers and Sewage Disposal. Mr. LaDue is Chairman of the A.W.W.A. Committee on Municipal Water Works Organization. This latest evidence of a "Department of New and Used Water" is another example of dual roles for water works men, a trend that is becoming increasingly important to the water works field.

William T. Bailey, formerly Chemist at Council Bluffs, Iowa, is now Assistant Chief Engineer and Superintendent of the Department of Water at Kansas City, Mo. In his new position, he has charge of the new softening system just being put into operation at Kansas City.

Mr. Bailey served in the water department at Council Bluffs for 14 years. For his outstanding work at Council Bluffs and for his contributions to the science of water purification, he has been nominated by the Missouri Valley Section to receive the Fuller Award in 1942. He is currently Chairman of the Missouri Valley Section.

Neil Kershaw has left the position of Chief Chemist with the Indianapolis Water Co. and is now serving as Sanitary Engineer, Constructing Quartermaster, Fourth Corps Area, with headquarters at Atlanta, Ga.

Paul J. Dishner, formerly serving as Captain with the 112th Observation Squadron at Dover, Del., has been transferred to a new assignment which is in the Office of the Atlanta District Engineer in the Sanitary Engineering Section.

Cap. Dishner served with the 26th Engineers overseas in the first World War. Most recently he was Director of Public Utilities of High Point, N. C. He has also been Resident Engineer Inspector of the Public Works Administration and Assistant Engineer with the North Carolina State Dept. of Health.

W. E. Gilbertson, formerly Associate-Sanitary Engineer with the State Dept. of Health at Bismarck, N. D., is now Assistant Sanitary

(*Continued on page 20*)

(*Continued from page 18*)

Engineer, Malaria Control in Defense Areas Unit of the U.S. Public Health Service, stationed at Atlanta, Ga.

Paul W. Reed, formerly Assistant Engineer, Bureau of Sanitary Engineering, Indiana State Board of Health, is now serving as a First Lieutenant, 325th Field Artillery, Fort Bragg, N.C.

Mr. Reed joined the Bureau of Sanitary Engineering in February 1938, immediately after he was graduated from Purdue University. Except for 4½ months, during which he did post-graduate work in the Public Health School at the University of Michigan, Mr. Reed was with the Indiana Bureau continuously until military service. During the earlier period of his employment in the Bureau of Sanitary Engineering he devoted most of his time to the supervision of swimming pool operation throughout the State. This work included field surveys, report writing, and the review of plans and specifications. He was one of the guiding lights in the organization of a Swimming Pools Operators' Conference which has been conducted annually at Purdue for the past few years under the joint sponsorship of the Department of Physical Education, Purdue University; the School of Civil Engineering, Purdue University; and the Bureau of Sanitary Engineering,

(*Continued on page 22*)

Get Water "On The Run" FOR THIRSTY FACTORIES!

Water supply lines go in fast when you use ARMCO Spiral Welded Pipe. Long lengths, up to 50 feet, naturally mean fewer joints, less assembly work. Hauling and handling are fast because this pipe is amply strong without being burdened by excess weight. The job progresses on an "all-out" schedule.

Another advantage is that ARMCO Spiral Welded Pipe gives efficient, trouble-free service. Continued high flow capacity is assured by a smooth spun enamel lining that prevents tuberculation. Costly cleaning is out and pumping costs remain low. And especially important now, ARMCO "Spiral Welded" is shatterproof. Its ultimate strength is 50,000 to 60,000 lbs. per square inch, and it will stretch 25 to 30 per cent before breaking.

ARMCO Pipe also is widely used *inside* plants for many varied industrial applications. Diameters run from 6 to 36 inches; wall thicknesses, from 9/64 to ½-inch. You have a wide choice of coatings, joints and standard or special fittings. Write us. The American Rolling Mill Co., Pipe Sales Div., 1531 Curtis Street, Middletown, O.

ARMCO

ARMCO SPIRAL WELDED PIPE

(*Continued from page 20*)

Indiana State Board of Health. For the past $1\frac{1}{2}$ years Mr. Reed has devoted most of his time to public water supply control work.

An accelerated program of public health training is being offered beginning June 8 by the Department of Public Health of the Massachusetts Institute of Technology. This program will permit the completion of work for a Master's degree by February 6. The training programs at M.I.T. are organized for public health engineers, health educators and public health laboratorians, as well as for administrators. Special summer courses are also being offered.

The tenth annual Short Course in Water and Sewage Treatment has been scheduled for the University of Florida Campus, Gainesville, Florida, May 27–30. The Short Course will be conducted under the usual four-way sponsorship of the General Extension Division of the University, the College of Arts and Sciences, the Florida State Board of Health, and the Florida Section of the A.W.W.A.

The program will open with registration in the lobby of the Chemistry Building on the Campus beginning at 1:00 P.M., Wednesday, May 27.

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PROFESSIONAL SERVICES

(*Continued from page 22*)

An informal "get-together" will be held Wednesday evening at which time some motion pictures will be shown, and lecturers, operators, visitors and guests will be introduced.

Beginning at 9 A.M. Thursday, the short course program will take up the problems of water supply and treatment, also sanitation, during the national emergency. Emergency precautionary measures, priorities on equipment and supplies, emergency war repairs, sabotage, and operation with reduced personnel will be discussed authoritatively and at length. General problems of water supply and treatment in Florida will receive the usual attention. Due to the increasing interest in adequate sewerage disposal facilities for Florida communities, one-half day will be given to that subject.

During the 1941 short course, the Florida Section featured a "gadget contest." This contest created so much interest and brought forth so many gadgets that it will be held again with an increase in the number and amount of awards. First prize will be a paid registration fee of $10 for any of the three extension courses which the General Extension Division is making available to Florida operators, or one year's membership fee in the Florida Section of the A.W.W.A. Second prize will be one

(*Continued on page 28*)


WATCH DOG
WATER METERS
. . . built to give
LASTING SATISFACTION
The Worthington-Gamon Meters of today represent an experience of 85 years . . . dating back to the invention of the piston meter, in 1855, by Henry R. Worthington.
With 3,650,000 meters now serving thousands of communities, this organization offers to municipalities and water companies a product whose accuracy and low maintenance requirements have proved it to be a sound investment.
Write for literature.
WORTHINGTON-GAMON METER COMPANY
General Offices: HARRISON, NEW JERSEY
District Sales Offices and Representatives throughout the United States
WORTHINGTON-GAMON

WG1-2A

(*Continued from page 26*)

year's membership fee of $5 for the Florida Water Works Operators Association. Third prize will be the registration fee of $2 for the short course. Operators are urged to bring along any gadget they may have developed to make the operation of the plant, the laboratory, or the distribution more efficient or more economical. If the gadget is not readily transportable, a sketch and description of its features and use may be entered in the contest. A committee will be appointed to review and judge all entries.

The Examining Board of the Florida Water Works Operators Association will conduct an examination for all operators who wish to try for an operator's certificate under the voluntary plan of certification adopted by the association more than one year ago. Operators who plan to take this examination should begin preparatory work at once. A good part of the short course program will be devoted to the subject matter on which the operators will be examined.

A highlight of all previous short courses has been the annual banquet of the Florida Section. This banquet will be held on Friday evening at a place to be announced. There will be various entertainment features, gadget contest prizes will be awarded, and important announcements made.

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Dr. A. P. Black, Professor of Chemistry at the University and Secretary-Treasurer of the Florida Section of the A.W.W.A., is responsible for arranging the short course program. G. Manuel Turner of the General Extension Division will have charge of the local program arrangements.

A bulletin which lists the program in detail will be sent to interested persons at an early date.

"Symposium on problems and practice in determining steam purity by conductivity methods."—The technical papers and discussions comprising this symposium, recently published by the American Society for Testing Materials, were procured through the work of A.S.T.M. Committee D-19 on Water for Industrial Uses. Following an introduction by R. E. Hall who points to the significance of each contribution, there is a detailed discussion on Sampling of Steam and Boiler Water by Messrs. Belyea and Moody, a description on Experimental Methods of Determining Conductivity Correction for Dissolved Gases in Steam Condensate by Messrs. Whirl and Lower, and following this a contribution by D. S. McKinney covering Calculation of Corrections to Conductivity Measurements for

(*Continued on page 32*)

(Continued from page 30)

Dissolved Gases. A summary by P. B. Place of the methods and apparatus available for the elimination from steam samples of gaseous impurities that affect conductivity measurements is included and a new kind of conductivity apparatus for use with boiler waters and steam samples is described by A. R. Mumford. There is a general discussion on Conductivity Cells and Electrical Measuring Instruments. A combined bibliography on steam purity includes some 75 important references.

A copy of the publication in heavy paper binding can be obtained from the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa., at 60 cents a copy.

For repairing mains where a gap has been blown out by an explosion, the M.B. Skinner Co. of South Bend, Ind., has devised an adapter employing standard Skinner-Seal Bell Joint Clamp parts to splice a proper length of steel pipe to fill the gap. Complete details are available from the company which says it is in a position to make prompt deliveries to gas and water companies in probable air raid zones.

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A mean temperature difference calculator has been devised to aid in the approximation of heat transfer surfaces when preparing estimates or specifications for heat exchanger equipment. A limited number of these calculators are being made available at cost, 25 cents, by Alco Products Div. of American Locomotive Co., 30 Church St., New York, N.Y. The Alco M.T.D. Calculator includes scales for the calculation of the logarithmic M.T.D. as well as the M.T.D. Correction Factors for one-, two-, three-, four- and six-shell passes, and also "C" and "D" scales which permit multiplication and division operations.

•

Plans for the immediate erection of a plant that will substantially increase our supply of ammonia and its derivatives have been announced by E. M. Allen, president of the Mathieson Alkali Works, Inc., New York. In accordance with the terms of a contract that has just been signed, the new plant will be financed by the Defense Plant Corporation and will be erected and operated under lease by the Mathieson organization. The ammonia will be produced synthetically, through the use of a modification of existing methods, by combining hydrogen with nitrogen obtained from the air.

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(*Continued from page 34*)

In another phase of plant expansion, Peerless Pump Div. of the Food Machinery Corp. of Los Angeles, Calif., and Canton, Ohio, has acquired the Sterling Pump Corp. of Hamilton, Ohio, and Stockton, Calif.

Peerless will consolidate the Sterling Plant at Hamilton with the new Peerless manufacturing plant at Canton, Ohio. Sterling's Stockton plant will be merged with the John Bean Mfg. Co., Division of the Food Machinery Corp., San Jose, Calif. According to Vernon Edler, Vice-President and General Manager of the Peerless Pump Div., consolidation of the two manufacturing plants will greatly expedite handling of a tremendously expanded volume of pumps on order at both concerns, the present backlog of orders for pumps for defense being greater than any commercial backlog in the company's history.

The Pittsburgh Equitable Meter Co.'s fellowship at Mellon Institute under the direction of R. L. Wakeman has carried out research acquiring data now being put to use in the selection of materials to take the place of rubber in meter parts where substitutes are necessitated by current exigencies.

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"Information on Flexible Transparent and Translucent Substitutes for Window Glass" is an 8-page paper by R. J. Moore and H. W. MacKinney, published by the American Institute of Chemical Engineers. A limited number of reprints of the paper are available from A.W.W.A. headquarters at the nominal charge of 5 cents each for postage and handling.

Two-stage centrifugal pumps are described in detail in a well illustrated 12-page booklet, Form 7167, available from Ingersoll-Rand Co., 11 Broadway, New York, N.Y. The bulletin contains 28 photographs and cross-sectional views, extensive performance tables and a comprehensive tabulation showing friction of water in various sizes of pipes.

"With its financial skies brightening, Philadelphia now may choose between another orgy of planless spending, or the gradual adoption of a policy of pay-as-you-go based on long-range planning." Thus does Philadelphia's Bureau of Municipal Research epitomize in No. 1,540 of "Citizen's Business" its excellent presentation called "At the Crossroads," given here in full:

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"Philadelphia stands today at the crossroads. During this period of defense prosperity, it can take the road of planless spending, repeating the mistake of the 1920's, and experiencing again the tragedy of the 1930's; or it can take the road of husbanding its resources and planning for future public-works projects so that it may be able and ready to proceed with them in the post-defense period when business activity may slacken and public improvements can be made at lower cost.

"**The Mistake of the 1920's.** Still fresh in memory is the city's orgy of spending during the decade immediately after the World War. A vast array of costly public improvements were undertaken, practically all financed out of borrowings. Almost as rapidly as borrowing capacity became available it was used up by the authorization of new debt. As a result the city's net bonded debt grew from $140,288,000 in January 1921 to $418,289,000 in January 1931, and debt service (interest, state tax, and sinking-fund instalments on city bonds) mounted from $13,894,000 in 1921 to $32,011,000 in 1931. In addition, the city, while starting with a general-fund surplus of $1,839,000 at the end of 1920, developed a general-fund deficit of $7,543,000 by the end of 1930.

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"**The Tragedy of the 1930's.** Then came the tragedy of the 1930's. During those depression years, when the city should have been able to carry forward public improvements, taking advantage of the low level of prices and wages, and affording opportunity for employment to the unemployed, it was unable to do so because it lacked both the necessary revenues and a general borrowing capacity. Despite its spending far beyond its income, it even failed to provide adequate maintenance for the existing municipal plant, notably the waterworks. Meanwhile the general-fund deficit soared, until in 1939 it became unmanageable and the city was forced to raise $41,000,000 through the sale of its 'gas rentals' for a period of years to pay floating debt and fill gaps in the 1939 budget.

"**A Brighter Prospect for the 1940's.** Today a brighter prospect looms before us. The city is operating on a balanced budget, and will end this year with a surplus. In the years immediately ahead, the city will benefit from substantial reductions in debt service. Through the retirement of maturing bonds alone the city's annual debt service on bonds outstanding at the beginning of this year will step down, under the 1941 total, by about $3,600,000 in the next four years. Further reductions will occur in later years. In addition, there will be large savings from refundings of callable bonds at lower interest rates. The revival of business activity, moreover, may be expected to increase the city's revenues, turn upward the trend of the assessed valuation of taxable property, and hasten the day when the city will have again a general borrowing capacity.

"**At the Crossroads.** Both danger and opportunity lie in this prospect. The danger is that the city may repeat the mistake of the 1920's, thus setting the stage for re-enactment of the tragedy of the 1930's. The opportunity is that, by avoiding past errors, Philadelphia may greatly reduce its burden of debt and prepare itself to meet another depression with a minimum of hardship. More specifically, instead of borrowing for practically all capital outlays, the city should finance a constantly increasing share of such outlays out of revenues; instead of using up its general borrowing capacity as it becomes available, the city should reserve borrowing power against the day when public-works projects will be needed to take up the slack in business; above all, instead of constructing public improvements in haphazard fashion, the city, with the aid of a revitalized planning commission, should prepare and keep up to date a long-range program of city improvements."

(*Continued from page viii*)

SLOAN, GARRETT. Regional San. Engr., Louisana State Dept. of Health, New Courthouse, Alexandria, La.
STEIB, F. L. Gen. Mgr., Water Works & Lighting Com., Wisconsin Rapids, Wis.
TANKARD, ERNEST E. Supt., Berlin Water Works, 292 Prospect St., Berlin, N.H.
TUGGLE, H. G. Director of Sanitation, Memphis-Shelby County Health Dept., 117 Courthouse, Memphis, Tenn.
ULINE, B. A. Secy. & Gen. Mgr., Nappanee Utilities Co., Nappanee, Ind.
VINSON, A. T. Pres., Vinson Specialty Paint Co., Burgess Bldg., Jacksonville, Fla.
WEIGHT, WALTER O. Dist. Mgr., Hersey Mfg. Co., 450 E. 3rd St., Los Angeles, Calif.
WILSON, JACK H. Asst. Engr., Little Rock Munic. Water Works, Little Rock, Ark.

Corporate Members

HAWTHORNE MUNIC. WATER WORKS. Hawthorne, Calif.
HILLSBORO UTILITIES COM., Richard E. Wiley, Supt., City Hall, Hillsboro, Ore.
MINERSVILLE, MUNIC. AUTHORITY OF THE BOROUGH OF, Carl I. Kear, Gen. Mgr., Delaware Ave. & Carbon St., Minersville, Pa.
PAN AMERICAN REFINING CORP., R. H. Price, Research Lab., Texas City, Tex.
TEXAS GULF SULPHUR CO., INC., J. W. Schwab, Assay Office, Newgulf, Tex.

Associate Members

STOKVIS, R. S., & SONS, INC., George R. Woods, Mgr., 17 Battery Place, New York, N.Y.

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Affiliates

HOWARD, ARTHUR W. Mayor, Water Com., City Hall, Bellingham, Wash.
TENNEY, RALPH C. Pres. of City Council, Water Com., City Hall, Bellingham, Wash.

Reinstatements—Active Members

DECKER, WALTER C. Supt., Munic. Utilities, Lawrenceburg, Ind.
JONES, FRANK WOODBURY. Partner, Havens & Emerson, 1140 Leader Bldg., Cleveland, Ohio
MILLER, WARREN C. City Engr., City Hall, St. Thomas, Ont., Canada
TRELLES, ERNESTO E. Quimico-Bacteriologo, Jefe del Servici, Acueducto de la Habana, Calle 12 No. 515, entre 5a. y 6a., Ampliacion de Almendares, Marianao, Havana, Cuba

Reinstatements—Corporate Members

BINGHAMTON BUREAU OF WATER. Simon P. Carman, Asst. City Engr., Municipal Bldg., Binghamton, N.Y.
BUFFALO DIV. OF WATER. Alan D. Drake, Director, City Hall, Buffalo, N.Y.
EAST YORK, TOWNSHIP OF. Grant R. Jack, Comr. of Works, 443 Sammon Ave., Toronto, Ont., Canada
TILLSONBURG PUBLIC UTILITIES COM. J. E. Teckoe Jr., Supt., Tillsonburg, Ont., Canada

Reinstatements—Associate Members

DEARBORN CHEMICAL CO. C. I. Loudenback, Industrial Dept., 310 S. Michigan Ave., Chicago, Ill.

Resignations—Active Members

ARCHIBALD, J. G. 457 Buller St., Woodstock, Ont., Canada
BEVAN, LYNNE J. Cons. Engr., 7 Dey St., New York, N.Y.
MARSHALL, GEORGE A. Chief Clerk, Bureau of Water, 108 City Hall, Portland, Ore.
REESE, HERBERT J. Supt. of Filtration, 52 High St., Mt. Clemens, Mich.

Resignations—Affiliate Members

BINZER, H. A. Water Comr., Water Dept., City Hall, Bellingham, Wash.
HANNING, B. E. Water Comr., Water Dept., City Hall, Bellingham, Wash.

Deaths—Active Members

DUNWOODY, J. S. Supt., Water Dept., Erie, Pa.
FISHWICK, E. T. Vice-Pres., Worthington Pump & Machinery Co., 401 Worthington Ave., Harrison, N.J.
HAWLEY, GEO. W. Deputy State Engr., Div. of Resources, Sacramento, Calif.
REYNOLDS, ABEL. Treas., New England Water, Light & Power Associates, 833 Hospital Trust Bldg., Providence, R.I.
RYAN, GERALD D. 1017 Gregg St., Columbia, S.C.

Transfers Between Sections

DRAKE, ALAN D. From Four States to New York
DUNMIRE, E. H. From Missouri Valley to Illinois
HENDERLITE, JAMES H. From North Carolina to Virginia
KAUFMAN, R. A. From New England to New York
MEISSNER, WM. A., JR. From Ohio to Four States
MOORMAN, R. L. From Kentucky-Tennessee to Four States
OLSEN, A. K. From Missouri Valley to Canal Zone
PEARL, EMANUEL H. From Four States to Southwest
QUIGLEY, T. T. From Illinois to New Jersey
SCHAEFER, WALTER A. From New Jersey to Virginia

NEWS OF THE FIELD

A major change in Selective Service policy was made public in a memorandum to all State Directors (I-405) dated March 16, 1942. This definitely announced the intention to retain an adequate supply of skilled, trained men in civilian services essential to the support of the war effort.

The American Water Works Association has made a formal request for the establishment of a "critical" list of occupations in the field of public water supply. A hearing was held on May 19th at which time substantial agreement was reached with reference to the various types of water works employment where the retention of trained men was essential. It is anticipated that the Selective Service System will shortly issue a directive memorandum to all local Boards. It will be promptly brought to the attention of A.W.W.A. members whenever it becomes available.

Members should read carefully memorandum I-405 which appears in the text portion of this issue of the JOURNAL. Whenever the critical list of water works occupations issues, it will be incumbent upon water works executives to bring it to the attention of a draft board whenever the status of any trained employee is being considered by the board. Such boards cannot be expected to defer skilled water works men if the head of the water department does not act in the interest of the department.

All applications for priority assistance which do not specify a required delivery date will hereafter be returned to the applicant by the War Production Board, it has been announced by J. S. Knowlson, Director of Industry Operations. Priorities Regulation No. One as Amended requires every applicant for priority assistance to specify in his application the latest date on which the items in connection with which priority assistance is requested can be delivered to him to meet his contract obligations or production schedules. Nevertheless, many applicants, especially those submitting individual applications on PD-1A forms, have been specifying "immediately" or "at once" instead of filling in a definite delivery date. Hereafter, no such applications will be considered until an exact delivery date has been filled in.

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The War Production Board has set up machinery to handle electric power shortages whenever and wherever they may occur. The first part of the program requires all utilities to operate their systems in a way that will produce the maximum amount of power from their present capacity. This in general calls for the integrating of systems to permit transfer of power from one locality to another. The second part of the plan establishes emergency curtailment schedules for various types of consumers and for times of peak demand.

Leroy H. Scott, Filtration Engineer, Oklahoma City, Okla., Water Dept., has been called to active service as a Captain in the Corps of Engineers. Capt. Scott is well known as an active water works man in the A.W.W.A. Southwest Section which honored him by choosing him for the Fuller Award in 1940. He was Filtration Engineer at Oklahoma City for 12 years.

Frank S. Taylor, for 15 years Water Works Superintendent-Chemist at Defiance, Ohio, has resigned that position to take up duties as Chemical Engineer for the Oklahoma City, Okla., water softening and filtration and sewage treatment plants. Before coming to Defiance in 1927, Mr. Taylor had been with the Newark and Greenville, Ohio, water departments.

W. H. Weir, formerly Assistant Director, Public Health Engineering, State Dept. of Health, Atlanta, Ga., is now serving as Major with duties at the Sixth Corps Area Headquarters, Chicago. Maj. Weir writes on May 13 that as far as he knows he is the first to arrive from out of town for the A.W.W.A. Conference on Wartime Water Works Problems.

Sidney W. Wells, formerly Chemist, Florida State Board of Health, is now serving as Lieutenant, U.S. Army Sanitary Corps. Lt. Wells is stationed at Ft. McClellan, Ala., attached to the Station Hospital.

David B. Lee, Director and Chief Engineer, Bureau of Sanitary Engineering, Florida State Board of Health, has been called to active duty in the U.S. Army Sanitary Corps. He is the third engineer to be called to the Army from that department.

A flexible, plastic tubing called "Saran" is now marketed by The Dow Chemical Company in sizes up to and including $\frac{3}{4}$-in. O.D. with wall thicknesses of 0.045, 0.062, 0.093 and 0.125 in. The 0.062-in. thickness is considered a stock size. Full information about this tubing which may be used for water services is available from R. J. Minbiole, The Dow Chemical Co., 30 Rockefeller Plaza, New York, N. Y.

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H. R. Welsford has been granted leave of absence from his position as Sanitary Engineer at Greensburg, Pa., for the Pennsylvania State Dept. of Health. He has been commissioned a Lieutenant in the U.S. Naval Reserve and is serving in the Salvage Division, Merritt-Chapman & Scott Corp., New York, N.Y.

Glen W. Campbell, formerly Chemist, Bellingham, Wash., Water Dept., and on active duty with the U.S. Army since April 1941, has now been promoted to the rank of Major, Chemical Warfare Service. Maj. Campbell, who was first commissioned in 1924, is a graduate of the Army's Chemical Warfare School at Edgewood Arsenal, Md., and has attended Willamette University, Salem, Ore.; University of Washington, Seattle; Washington State College; and the University of Oregon, Portland. His present assignment is at the Medical Field Service School, Carlisle Barracks, Carlisle, Pa., where he instructs Army Medical Field Service men in the various phases of chemical warfare.

Stuart M. Weaver has been commissioned a Lieutenant Colonel in the Army Corps of Engineers and assigned to the Washington Office of the Repairs and Utilities Branch, Construction Division, Office of the Chief of Engineers. Before being commissioned, he was serving Montclair, N.J., as City Engineer, Manager of the Water Department and Executive Assistant to the Board of Commissioners.

C. H. Bryson was appointed, effective May 1, to succeed the late B. B. McReynolds as Superintendent of the Water Division of the Department of Public Utilities, Colorado Springs, Colo.

Keith R. Chinn, formerly Plant Superintendent for the West Palm Beach Water Co. at West Palm Beach, Fla., is now serving as Lieutenant in Army Intelligence, stationed at Miami, Fla.

Chester A. Miller resigned his position as Chief Operator and Plant Superintendent at Canton, Ill., onApril 25 to take up the duties of Water Plant Superintendent for the Sherwin-Williams Defense Corp. ordnance plant at Carbondale, Ill.

John D. Johnson, formerly Assistant Superintendent, has been appointed Superintendent of the Erie, Pa., Water Department, succeeding the late J. S. Dunwoody. Johnson entered the employ of the Water Department at the age of thirteen, 35 years ago, as water boy and inspector, and except for service with the U.S. Army Engineers in France during World War I, has been with the utility ever since.

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George Papesch was named Assistant Superintendent in Mr. Johnson's place, and his former post as Chief Filter Operator will be filled by Robert A. Blair, who transfers from the Erie Works of the General Electric Co. Blair was Chief Chemist at the Perry Iron Co. for a number of years.

C. R. Knowles, Superintendent of Water Service for the Illinois Central System, has resigned from that position to retire from active duty. He has long been active in the field, having been an Active Member of the A.W.W.A. since 1913. Mr. Knowles' successor is G. E. Martin, formerly in the post of Supervisor of Bridges and Buildings, Paducah, Ky.

Carl C. Lanford, Superintendent of Public Works at Newton, N.C., has left that position to become head of the water department at Greer, S.C. B. L. Pope, formerly at Monroe, N.C., is the new Superintendent at Newton, N.C.

W. W. Towne returned to his post as State Sanitary Engineer with the South Dakota State Board of Health on June first, after a year's leave of absence, which he spent at the University of Missouri. There he served as Visiting Assistant Professor of Civil Engineering, teaching

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Sanitary Engineering. Mr. Towne has long been active in the field, having been a member of the A.W.W.A. since 1929.

Dean E. McCrory, attached to the Pittsburgh office of the heavy chemical sales division of the Pennsylvania Salt Manufacturing Company since 1936, has been transferred to the company's executive offices in Philadelphia. He will be concerned with the sales of a number of products of the company. Mr. McCrory attended Franklin and Marshall College and holds a graduate degree in Sanitary Engineering from Carnegie Tech.

Interpretations of the Uniform System of Accounts for Water Utilities are covered by numerous bulletins of the National Association of Railroad and Utilities Commissioners, 7411–15 New Post Office Bldg., Washington, D.C. A consolidated document covering cases 1 through 51 costs $1.50. Also of interest to water works men are: "Rules Governing the Preservation of Records of Water Utilities" at 50 cents, and "Interpretations of Rules Governing Preservation of Records of Water Utilities" at 25 cents per copy.

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The owners of the Northern Illinois Water Co. have purchased the St. Louis County (Mo.) Water Co. at the price of $3,350,000. The United Gas Improvement Co. of Philadelphia, a registered holding company, had been ordered to dispose of the St. Louis County Water Co. within a year, under the so-called "death clause" of the Federal Holding Company Act. A year ago when the County Court of St. Louis County negotiated to purchase the water utility, the price then considered was $4,500,000, or $1,150,000 more than the recent actual sales price.

The Northern Illinois Water Co. also operates plants in Champaign, Urbana, Streator, Sterling and Pontiac. John G. Getz Jr. is President of the Northern Illinois Water Co. and he and Louis J. Nicolaus and Joseph D. Murphy were elected directors of the St. Louis County Water Co. to replace three directors who had represented the Philadelphia interests.

The need for economy in tin has made it necessary to consider the modification of the composition of solders composed chiefly of tin. A second edition of the monograph "Tin Solders" has been issued by the British Non-Ferrous Metals Research Assn., Euston St., London, N.W.1. The first edition, written by S. J. Nightingale, has been thoroughly revised

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by Dr. O. F. Hudson and brought up to date in the light of investigations carried out in the last ten years in various laboratories. Important new sections have been added to cover the creep properties of solders and soldered joints. The new edition sells for $2.75 post free in the United States.

"War Protection of the Gas Industry" is a comprehensive book in looseleaf form recently issued by the American Gas Assn., 420 Lexington Ave., New York, N.Y. A considerable portion of this book deals with damage to streets in which case both water and gas mains may be involved. Additional releases to supplement the original material will be issued from time to time. C. George Segeler, Engineer of Utilization of the A.G.A., has offered to extend the A.G.A. member price of $2.50 to members of the A.W.W.A. who would like copies of the material.

Wallace & Tiernan Co., Inc., at its Newark, N.J., plant, early in May put into operation a new plan in aiding Navy Relief. Devised as a means to permit every employee to contribute without burdening the family budget, this plan is thought to be original with Wallace & Tiernan Industries. During the week, each of the 1,500 employees gave one hour of overtime work. The value of this work was calculated in terms of finished products and a sum representing an additional contribution of the Company was added. Thus, a check for $6,500 was given in the New Jersey Navy Relief campaign.

"Testing Water Meters, Why, When and How" is a fine, new, 40-page, heavy covered booklet issued by the Ford Meter Box Co., Wabash, Ind. It has a wealth of technical information, charts, tables, illustrations and bibliography, covering all that its title suggests. This attractive publication, as well as a complete general catalog, is available upon writing to the Company.

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Pumping.—Sewage Treatment.—and Water Purification Equipment

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REPORT OF THE CANADIAN SECTION CONVENTION

The Twenty-Second Annual Meeting of the Canadian Section, held at the General Brock Hotel, Niagara Falls, Ontario, on April 15–17 was singularly successful. In spite of those factors which might be considered likely to have an adverse effect the attendance reached the high figure of 410, only 35 less than the all time high. Membership in the section reached the new peak of 266.

For the first time in many years the Equipment Association did not place any exhibits, because the manufacturers were too busy with war activities. Instead, a "water works club room" was introduced by the manufacturers. It was an outstanding success as a social get-together, and rendezvous for the delegates. The technical sessions were unusually well attended; and the banquet brought the highest attendance on record—350. President Howson and many other members from the United States were present. An innovation was the issuance of "membership service awards" to individuals with fifteen years or more continuous membership in the Association.

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The conference was opened by Chairman William Storrie at a luncheon attended by over 200. President Howson was guest speaker, and briefly reviewed association affairs.

The program of this convention was divided into five written papers and five "guided discussions." The latter have been features of these meetings in recent years. Instead of the usual round table discussions these are guided by the chairman and a limited number of persons who are asked in advance to take part.

The opening day's program included two written papers. The first of these, on "The Future of Water Chlorination," was given by H. A. Faber, Research Chemist, Chlorine Institute, New York. The developments in chlorination were reviewed in order to predict some of the many possibilities for the future.

The second paper was given by H. F. Wagner, Chief Chemist, Division of Water, Department of Public Works, Buffalo, on the subject, "Influence of Plant Design and Construction Upon Filtration Problems, Illustrated by Special Reference to Buffalo, N. Y." The speaker reviewed a number of features such as filter media, washing, chemical feeds, water storage, etc., and related the design of the plant to the needs of the operator.

The first of the "Guided Discussions" was on the subject, "Reservoirs and Water Tanks," and was under the chairmanship of W. L. McFaul of Hamilton. This included such matters as the need for reservoirs, the capacities required, the types, construction details and methods of waterproofing.

The business meeting of the Section resulted in the election of O. H. Scott, Manager of the Public Utilities Commission at Belleville as Chairman, and G. H. Ferguson of Ottawa and W. H. Waddell of Owen Sound as Trustees for three years. No decision was made on next year's convention city.

Two papers on wartime activities were a feature of the second day's meeting. M. J. McHenry, Priority Officer of the Ontario Hydro-Electric Power Commission at Toronto, gave a paper, "War-Time Supply Problems," which will be found in this issue of the JOURNAL. This was followed by a paper by A. E. K. Bunnell, Director of Utilities, Service Administration, War-Time Prices and Trade Board at Toronto, also published in this issue.

The executive of the Section met the past chairmen who were present in an open discussion on means for improving the Section. A number of useful suggestions were made, and the group was fortunate in having the opinions of President Howson and Linn H. Enslow.

Inspection of the 10-mgd. water filtration plant of the city of Niagara Falls occupied one afternoon.

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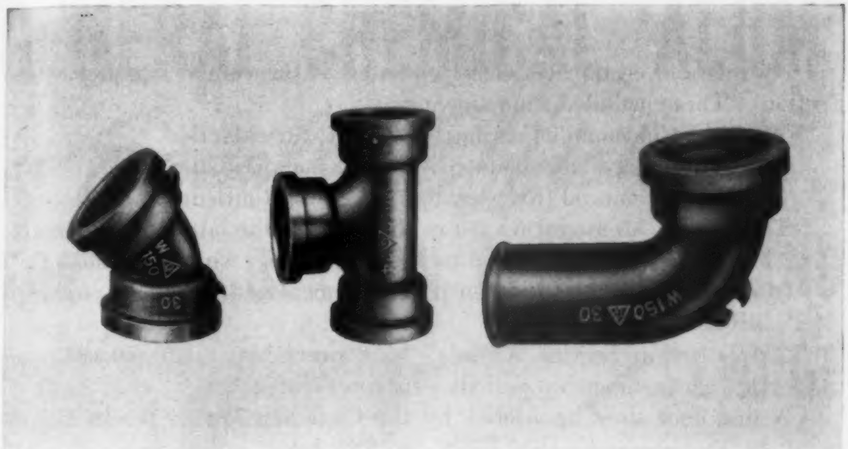

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Awards and certificates were presented at the annual banquet of the Section. These included the following:

The Past Chairman's Certificate to G. H. Strickland

An ebony case, silver-mounted, to Chairman William Storrie.

The Hunt Memorial (for operators) to G. G. Routledge, Toronto.

The Section Memorial Award in the name of the late F. P. Adams.

The Fuller Memorial Award to Professor R. W. Angus, Toronto.

Mementos of office to eleven past chairmen in the form of engraved silver-mounted canes.

"Membership Service Awards" to 65 members. [15, 20, 25. and 30 year membership periods were represented.]

A fine floor show sponsored by the Canadian Water Works Equipment Association, and a showing of the film taken at last year's Toronto convention, rounded out the evening.

The final day brought forth a paper by N. G. McDonald, Consulting Engineer, Toronto, on "Modern Trends in Pumping Station Equipment." It was a comprehensive review of matters of importance to operators and designers and will be presented soon in the JOURNAL.

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A "guided discussion" which evoked many questions and answers covered "Maintenance of Filter Beds and Control Equipment." This included the problems of filter media, underdrains, operation of filters, overhauling and related matters.

Time was given also to a consideration of an increase in water consumption in Canadian municipalities and means for meeting this abnormal condition. Figures were prepared to show the extent of this increase in recent years, and to see how the war efforts have been related to this.

The final discussion of the convention, led by Mr. Storrie, was under the general heading of "Wartime Water Works Problems." Priorities on supplies, wage bonuses to employees, ice trouble in intakes, and the disposal of surplus funds from water works utilities were topics included in the discussion. In Ontario, surplus funds from the water works utilities are to be turned over to the municipal councils, an action which is not at all favored by the commissioners. A resolution was adopted asking the section to help clarify the interpretation of legislation on this point.

A. E. BERRY
Secretary-Treasurer

REPORT OF INDIANA SECTION MEETING

The Thirty-Fifth Annual Meeting of the Indiana Section was held at the Union Building, Purdue University, Lafayette, Ind., April 9 and 10. The keynote of the convention was "Maintaining Good Water Service in Times of Emergency." L. A. Geupel, Superintendent of the Evansville Water Works, presided at the two day conference, which had a registration of 190 and a Henshaw Cup rating of 52.8 per cent.

A Program Committee, consisting of Frank Jordan, Past A.W.W.A. President, M. H. Schwartz, B. A. Poole and L. A. Geupel, provided a program which was voted one of the best in the Indiana Section's long history.

B. A. Poole was chosen as the Fuller Award candidate for his leadership in the State Board of Health activities, his long and continued interest

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in the affairs of the Indiana Section and his assistance in the preparation of the Mutual Aid Plans now in effect throughout the state in conjunction with the activities of the Indiana State Defense Council.

Mr. Howson, dinner speaker on April 9, chose as the topic of his address "Repairing For Defense." It is printed in this issue of the JOURNAL.

L. A. Geupel, in opening the meeting, summarized the 1941 activities of the Section briefly by pointing out that the new Emergency Committee had been the logical successor to the earlier Mutual Aid Committee and outlined the organization and work of the new committee which is sponsored by the State Board of Health and affiliated with the Indiana State Defense Council. The committees were commended for their co-operation and interest during the past year.

President Elliott, of Purdue University, in an inspiring talk emphasized the need of the water utility man in today's defense effort. Members of the A.W.W.A. were described as promoters and defenders of the most important and fundamental thing on earth, a potable water supply.

Otto Jensen, State Examiner of the Department of Inspection and Supervision of Public Offices, presented a comprehensive picture of the

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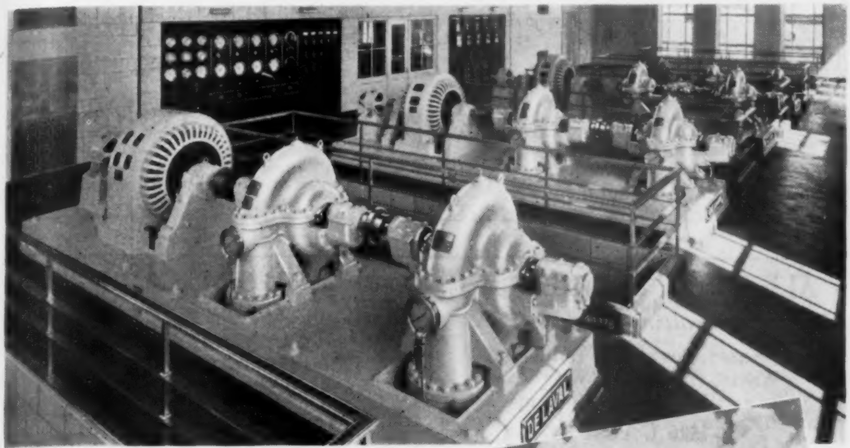
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PROFESSIONAL SERVICES

(*Continued from page 22*)

relationship which should exist between the accountant and the plant superintendent. It appears elsewhere in this issue of the JOURNAL.

B. A. Poole and Paul Reed of the Indiana State Board of Health collaborated on a paper, "What Can the Water Plant Superintendent Do in the Emergency." Their conclusions were that the place for the water works man during the current emergency is in the water works business. "Your job, one never to be taken lightly, must be considered doubly serious now. You must strive to produce the best water ever produced, without benefit of many of the improvements which you have planned, and at the lowest practicable cost. You must plan for the worst possible emergency, rehearse and replan. If no emergency develops your organization and system will still be the better for the planning. If an emergency does develop you will not have been found wanting."

A paper on "The Trends in Personnel Today" was presented by Miss Esther Rains of the Indianapolis Water Company. Miss Rains pointed out that today's personnel problem, like so many of the operating and managerial problems, is in a constant state of flux. It has been necessary to revise job specifications and employment requirements due to the quality of persons available for employment.

Harry E. Jordan paid an impressive tribute to the four members of the Section whose death occurred last year. The new regulations and restriction orders have required considerable attention on the part of the New York office and close co-operation and a helpful understanding of the industry's problems have been obtained through visits with officials in Washington. The maintenance of good water service in times of emergency was stressed by Mr. Jordan.

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The film "Join the A.W.W.A." was presented through the courtesy of the Industrial Chemical Sales Division.

The Technical Committee report, made by F. A. Schaefer of New Albany, Ind., Chairman of the committee, told of the projects considered by the committee before the emergency, and of the shift in emphasis to defense needs made after December 7. Progress has been made on a number of the following projects:

(1) Study of frost penetration
(2) Paint manual
(3) Study of water level of ground supplies
(4) Development of frost proof meter pits
(5) Defense and emergency mutual aid plan
(6) Distribution manual
(7) Tuberculation
(8) Emergency fencing study
(9) Emergency main repair manual

Mr. Schaefer pointed out that two reports of last year's committee activity were reprinted in the A.W.W.A. JOURNAL. The Technical Committee recommended that consideration be given to the appointment of a research man at Purdue to correlate the findings of other utility and highway research agencies and study the problems that affect the water utilities of Indiana.

"Our Water Resources," the subject of an address by Hugh A. Barnhart, Director, Department of Conservation State of Indiana, dealt with the problem of the gradual depletion of the underground water throughout Indiana. The shrinkage of the Northern Indiana Lakes has been a serious concern of the Conservation Department and with the droughts experienced in recent years, definite steps should be considered to provide reservoirs at strategic sites to control the stream flow. A study of the decline in the water table throughout Indiana was presented. Reforestation was emphasized as playing an important part in today's attack on the problem of adequate water resources, and the state Conservation Department is at present selling three million trees annually for planting purposes, with an ultimate of 15 million trees for sale within five years. The building of 2,500 low dams in streams and several hundred larger earth dams has been encouraged by the Department. The value of the continued co-operative investigation between the U.S. Geological Survey and the Department of Conservation was emphasized but the scope is curtailed due to lack of sufficient funds.

The following resolution was passed unanimously:

Be It Resolved:

That this Association be on record as favoring an appropriation in the amount of $20,000, requested by the Indiana Department of Conser-

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vation to be used in furthering the studies of that Department in the conservation of ground and surface water supplies.

Respectfully submitted, P. H. Reardon, Fred H. Brune, and Leo C. Matthews.

Ralph J. Young, Safety Director of the Public Service Company of Indiana, Inc., made a dramatic presentation of a safety message. "If we could save the man-hours lost from work accidents," Mr. Young averred, "the possible production represented by those man-hours alone might be the balance of power in World War No. 2. We can stop these accidents by a safety educational program that will teach us to recognize accident set-ups and eliminate them."

Two representatives of the State Fire Marshal's Office, Robert F. Hamm, Assistant Director, Educational Division, and Gordon Sherer, Attorney and Chief Investigator, presented stories on means used to prepare for efficient fire protection, how to avoid arson and sabotage and the necessary precautions that can reasonably be taken.

A sound picture, "The Bombing of London," was presented through the courtesy of the Cast Iron Pipe Research Association. A second picture, showing recent methods of repairing large cast-iron mains by an

(*Continued on page 32*)

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eastern metropolitan gas company, was presented. Dewey Johnson talked on emergency war repairs for the water system and the desirability of providing sufficient mechanical joint repair material was mentioned.

Frederick F. Eickhorn, Chairman, Public Service Commission of Indiana, addressed the April 10 luncheon on "Utility Operation During This Emergency." Problems encountered in meeting the demands for service and protection of property to insure continuity of service were thoroughly covered from a regulatory point of view.

"Some Critical Problems in Our War Effort" was the subject of a thought-provoking talk by A. A. Potter, Dean of Engineering, Purdue University, on April 10. The conflicting ideologies of "Mein Kampf" and the Bill of Rights are the answer to the question "Why Are We at War?" Japan gave us no choice when she attacked Pearl Harbor and the answer to the question "Could We Have Kept Out of War?" is obvious. Close relationship with Russia was deemed essential by Dean Potter. The necessity of Training For Victory was developed from the absolute need of 15 million defense workers by 1943. Defense industry could absorb during the present year ten times the output of all engineering colleges. The new training schedule with year round teaching will accelerate the

(*Continued on page 34*)

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number of graduates available for the defense effort. The training in industry program provided opportunities to 107,000 people during the period of January to August, 1941; this year's program has been expanded to provide special training for 550,000 people. Dean Potter concluded his address with "It is our responsibility, as citizens, to demonstrate our superiority as a free, courageous, tolerant and united people, who have no individual or group differences at a time when the very ideals of our form of government are at stake. Let us pull together to insure a total victory for American idealism in its struggle against the ideology of the most unscrupulous and inhuman totalitarian racketeers of all times."

The closing session of the meeting consisted of a round table discussion of emergency precautionary measures.

The 1942–43 officers elected were: Chairman, E. F. Kinney, Wallace & Tiernan Co., Indianapolis; Vice Chairman, E. F. Niemeyer, Indianapolis Water Co., Indianapolis; Secretary-Treasurer, H. G. Horstman, Public Service Co. of Indiana, Inc., Indianapolis; and Assistant Secretary-Treasurer, P. H. Reardon, Marion Water Works, Marion.

Herman G. Horstman
Secretary-Treasurer

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A bibliography on taste and odor control has started appearing with the March 1942 issue of the "Taste and Odor Control Journal," published monthly by the Industrial Chemical Sales Div. of West Virginia Pulp and Paper Co., 230 Park Avenue, New York, N.Y. The bibliography will ultimately comprise about 1,000 items and will probably be presented in alternate months until complete.

Commemorating its fiftieth anniversary, the Mathieson Alkali Works, Inc., has published a 48-page booklet entitled "Fifty Years of Chemical Progress." The booklet traces the growth of the Mathieson organization and describes the company's major developments, which include the introduction of liquid chlorine and synthetic ammonia, the preparation of new chlorine carriers, bleaching agents, and detergents, and the production of alkalies of an exceptionally high degree of purity. Numerous illustrations show the scope of the company's present operations. Copies of the booklet can be obtained by mailing requests to the Mathieson Alkali Works, Inc., 60 East 42nd St., New York, N.Y.

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The National Fire Protection Association, 60 Batterymarch St., Boston, has issued a very comprehensive book, "Training Manual for Auxiliary Firemen." It contains 416 pp. and 225 illustrations, is $7\frac{5}{8}$ by $5\frac{1}{4}$ in., and costs $1.50. It contains a great deal of interest, covering the use of special equipment and methods of using available water supplies.

The Fifth Annual Short Course for superintendents and operators of water and sewage plants in Louisiana and the annual meeting of the Conference of Water and Sewage Plant Operators held on the University Campus at Baton Rouge, La., on June 2–4, was designed to include the following:

Progress of Itinerant Schools, conducted by the State Department of Education

Maintenance of Water and Sewage Services During Emergencies

Priorities System as It Affects Public Water Supplies and Sewage Systems

Design and Maintenance of Rate Controllers

Laboratory Demonstration on the Care and Maintenance of Pumps and Electrical Motors

Laboratory Demonstration of the Bacteriological Examination of Water Samples

Trends in Design of Modern Water and Sewage Treatment Plants

Iron Removal From Well Waters

Procedures to Be Followed in Chlorination of Water Supplies

Laboratory Demonstration of Break-Point Chlorination

Stream Pollution Control in Lousiana.

Examinations were for issuance of certificates for Class B and Class C water plant operators.

"The Steady Pursuit of Waste Pickle Liquor Utilization" is an abstract from the Twenty-Ninth Annual Report of the Director of the Mellon Institute, given in the April 10, 1942, "Chemical and Engineering News." Parts of interest to water works men are quoted:

"The acid recovery fellowship of the American Iron and Steel Institute (R. D. Hoak, senior fellow; W. H. Hodge, advisory fellow) has continued, during its fourth year, to evaluate processes designed to recover values from waste pickle liquor, to propose and investigate the potentiali-

(Continued on page 40)

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ties of new procedures, to confer with public health and municipal officials in the solution of problems arising through inadequate pickle liquor treatment, and to advise the technical staffs of steel mills on treatment or disposal methods which best meet their particular requirements. . . .

"The saturation of the market for copperas has induced the fellowship to inquire into the conversion of this compound into other iron salts for which wider uses exist. The employment of ferric sulfate as a pickling agent for stainless steel is increasing and has the advantage of releasing nitric acid and dichromates for war needs. Ferric chloride is utilized as a sludge conditioner in 85 per cent of the sewage treatment works which apply vacuum filtration. As research continues to establish the advantages of iron salts in water purification and in the treatment of sewage and organic industrial wastes, these compounds will receive recognition from potential users. The fellowship has developed interesting possibilities for the manufacture of compounds which find a large field of utility."

Members of the Western Pennsylvania Section of the A.W.W.A. will recall the paper given before their meeting in August 1941 by Mr. Hoak. This paper was not made available to the A.W.W.A. for publication in the JOURNAL.

The persistent efforts and continual contributions of a great number of A.W.W.A. members to pollution abatement make this an ever vital subject for the A.W.W.A.

REPORT OF PACIFIC NORTHWEST MEETING

Contrary to dire predictions of many of us, the attendance at the convention exceeded all expectations. "Guestimates" ranging from a corporal's guard to 135 were lost in the limbo of Friday morning's registration. The final registration, obtained by Milton McGuire, was 201, and the attendance throughout the program was excellent. The convention was held May 8 and 9 at the Marcus Whitman Hotel at Walla Walla, Wash.

Because of the demand by the war on the various water superintendents, the program had been streamlined by the elimination of the banquet, trip, and golf tournament. In spite of the severity of this streamlining, everyone had a good time. It has been the policy of this section to maintain a strong Program Committee, dropping the oldest member each year and adding a new member. In this way continuity of program over a period of years is obtained and much experience is gained. The members of the Program Committee take turns and preside at half-day sessions with the result that this Program Committee is a working committee.

Walter Moore, of Eugene, presided at the Friday morning session which started after a rather unusual greeting had been given by the Commission of Finances of the City of Walla Walla.

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1941
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HYDRODARCO
FOR WATER PURIFICATION
POWDERED
DARCO CORPORATION
RECORDS
PROVE
IT!

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Max Campbell, genial State Sanitary Engineer of the State of Washington, brought us up to date on the liabilities of water works. He was questioned at the end of his paper by several water superintendents, and in typical legal manner retreated behind a barrage of legal technicalities. In spite of this retreat, Mr. Campbell left the superintendents feeling that they were morally responsible for the general health and well being of their communities.

"Pinch-hitter" Tom Judd, who left a few hours later to become a captain in the Army Air Corps, reported for Brian Shera on the Safety Committee's Report. Many facts were brought out concerning the loss in time due to accidents, and it was interesting to note that a great number of the cities reported showed no time lost for accidents involved on the job. Mr. Howson commented upon this report, hoping that it would be sent to the National Safety Committee in Chicago.

Mr. Howser of the Seattle Water Department repaired and replaced mains with a preliminary school session on the blackboard. Gadgets of all kinds were discussed to make repairs to pipe lines simpler, and, as usual, many contributions were received from the floor. Ideas were swapped quicker than stocks and bonds in a falling market, but Gosney, of Auburn,

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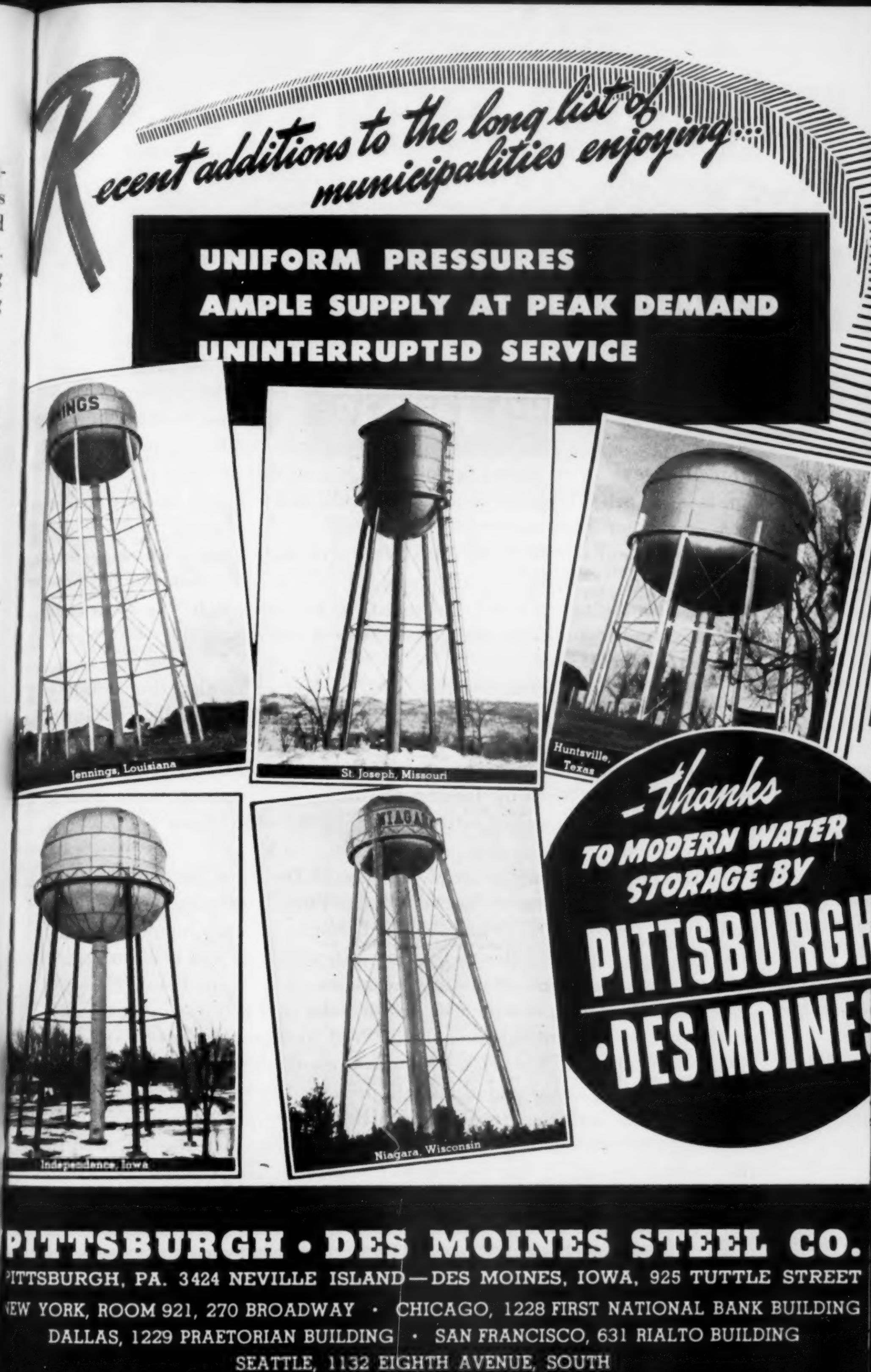

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finally could restrain himself no longer and went to the blackboard talking and drawing diagrams on the repair of wood stave pipe by concrete. To list the names of the men who participated in these sessions would require the publication of the registration list.

J. Guy Eernisse, of Tacoma, read a paper in the afternoon on "Recent Developments in Corrosion Control." The paper was divided into two parts, one dealing with new pipe line construction of concrete and steel and transite pipe, and the second part with corrosion control of existing structures. A considerable part of the paper was devoted to the effects of cathodic protection and an economic study of the cost of reconditioning the four standpipes in Tacoma. According to Mr. Eernisse, using the cost figures developed at Tacoma and applying them to a mile of pipe, cathodic protection gave an estimated saving of $5,354 on a 32-in. steel pipe. This pipe is layed below high tide in all types of fills and adjacent to main traffic arteries.

An excellent picture of the construction of Bellingham's water system was shown by M. B. Byron, who replaced John Cunningham on the program. This picture in color, along with a picture which was shown on Saturday afternoon, showed the possibilities of publicising the water works system to John Q. Public.

After the short intermission declared by Harold Fowler, the presiding Chairman, Dick McLean, host superintendent of Walla Walla, explained in chronological order the developments of the water works system. This was so easily told that before the superintendents could compose themselves from the severe attacks by Indians on the block houses of Walla Walla, Dick McLean had vanished into thin air like the red Indians he had been speaking about.

Mr. Harsch, representative of the Asphalt Institute, gave an excellent treatise, "Asphaltic Enamel for Steel Water Pipes," bringing out the point that if said coatings are wrongly applied poor results are bound to ensue.

The buffet supper followed by the business session was held on Friday evening, and the highlight of this event was a talk by Louis Howson, A.W.W.A. President, in which he stressed the necessity for inventiveness on the part of superintendents and the need to conserve materials of war. He stressed also the importance of the work of the National and Local Committees, and at the end of his talk presented to Fred Jones, Chairman of the Section, both the Henshaw and Hill Cups which were won in 1941. National Director Lindsay made his annual report which was followed by the annual report of the Secretary-Treasurer. The George W. Fuller Memorial Award was made at this time by Wm. P. Hughes, Chairman of the Committee, to Milton McGuire, Manager, Water and Light Department, McMinnville, Ore. Winston H. Berkeley, of Lewiston, was awarded the Gadget Prize Award for a home-built comparator. The Licensing

(*Continued on page 46*)

How A modern METER CONSERVATION program will

INCREASE WATER REVENUE

REDUCE OPERATING COSTS

...commendations ★ for a ...ter Conservation Program

...emove all meters ...r a certain period ... time or after a cer... total consumption, ...combination of both.
... Test them when ...ought into the shop ... repairs, keeping a ...ord of these tests. ... at rate of flow in ...llons per minute.
... Repair them care...lly, especially the ...mbers and gear ...ins, keeping a rec...d of repair costs, both ...rts and labor.
... Test them after re...irs, requiring a high ...rcentage of registra...n on a 0.25-g.p.m. ...w.

PROPER meter conservation, instead of *increasing* the cos... of water to the consumer, has proved a means of *minimiz... ing* such costs by reducing water works operating expense... . . . to the extent that in some instances water rates in th... community have been substantially lowered, yet the wate... company has had funds to set aside for improvements an... extensions of the system.

Water companies, when starting a regular meter conserva... tion program of testing and repairing, will find that they hav... been losing much revenue due to under-registration of meters... Customers will no doubt complain of high water bills whe... meters have been restored to accuracy, but bills will decreas... when formerly unsuspected leaks have been stopped an... carelessness in the use of water has been eliminated. Record... kept will allow a much closer control over leakage losses whic... may occur from time to time.

On the whole, the Water Departments will be paid for ... much greater proportion of their pumpage. At the same time... pumpage will be materially reduced, resulting in a real saving... in fuel and chemicals. Multiply such savings by thousands o... small communities — savings in *materials* and in their *produc... tion-hours* released for WAR work — and you begin to visualiz... the Water Departments' contribution towards helping wi... the war.

Your experienced Trident representative will be glad t... cooperate with you in your meter conservation program . . ... and, in addition, you are invited to write us for our new... Booklet #597. It is a thorough and informative study of thi... important subject, based on actual practice.

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(*near Toronto*)

(*Continued from page 44*)

Committee rendered an excellent report and tried to obtain discussion from the floor. It was evident from the lack of discussion that the problem of licensing operators by legislation must be held in abeyance during the war period. The results of the election of officers for the coming year are shown on page iv of this JOURNAL.

Mr. Jones' chairmanship was never in better evidence than during the business meeting, which was run off with little or no lag. More than 190 were in attendance throughout this business meeting.

Bright and early on Saturday morning Wm. White called the session together to hear Carl Green bring up the problem of "Preparation of Auxiliary Water Supplies." Mr. Green, formerly State Sanitary Engineer of Oregon, treated his subject very well. The Saturday morning session may have been called a symposium on defense, so well was each part integrated. Bill Groce, special agent for the National Board of Fire Underwriters, in ringing tones warned the Section of sabotage, and from his many experiences in this field covering so many years he set forth conclusively that fire was the major agent used by all saboteurs.

With catchy slogans of "Keep 'em Flowing" and "Don't let them catch us with our water plants down," James B. Fisken, formerly engineer with the Spokane Water Department, contributed an unusual hour on the subject of "Civilian Defense and Air Raid Protection." This instructive and entertaining talk on the intimate details of Spokane's Water Department activities brought many men to the floor to question Messrs. Fisken, Lindsay, and Jones. This triumverate successfully answered many thought provoking questions.

The afternoon session, under presiding chairman James E. Morrison of Seattle, brought out an excellent attendance and an interesting program. The Emergency Defense Committee's report, which was furnished by Chester Morse, Superintendent at Seattle, discussed the pros and cons of emergency and remedial measures. At the end of the report the meeting was thrown open for discussion and action. The report was accepted with alacrity.

Major Arnold, Public Health Service Regional Sanitary Engineer of the Ninth Civilian Defense Region, took over the program and discussed the mutual aid plan for water service. It is inadvisable to repeat in this report the important factors which Major Arnold mentioned, but the intense interest of the group showed that much thought had gone into the plan and action would result therefrom. Mr. W. Powell, of Vancouver, B. C., discussed Major Arnold's paper in view of the experiences of the Canadians.

The meeting was declared a great success and everyone returned to his respective bailiwick impressed by the part which water plays in the national program.

FRED MERRYFIELD
Secretary-Treasurer

CHANGES IN MEMBERSHIP

New Members, Applications Received April 1 to 30, 1942

Active Members

ABELL, E. B. Owner & Mgr., Abell Water Co., Twentynine Palms, Calif.
ALTER, AMOS J. San. Engr., State Bd. of Health, 1098 W. Michigan St., Indianapolis, Ind.
AMUNDSEN, C. J. Secy.-Treas., Town of Claresholm, Alta., Canada
ASHLEY, FRED M. Comr. of Public Works, City Hall, Fresno, Calif.
BARTON, RUSSELL. Chairman, Water Works, Fort Erie, Ont., Canada
BLISS, B. F. Gen. Mgr. & Vice-Pres., Independence Water Works Co., 123 W. Kansas, Independence, Mo.
BOCK, FRED F. Executive, Artesian Well & Equipment Co., 30 Church St., New York, N.Y.
BOLIEAU, CLIFTON W. Assoc. San. Engr., Design Div., Tennessee Valley Authority, 215 Union Bldg., Knoxville, Tenn.
BORTON, FRED W. Member of Board, Dept. of Water & Sewers, % Miami Broadcasting Co., Postal Bldg., Miami, Fla.
BRADY, JOHN J. Designer, Div. of Water Purif., 1247 W. Garfield Blvd., Chicago, Ill.
CABLE, H. EDWARD. Mgr., Aluminate Chemicals Ltd., 555 Eastern Ave., Toronto, Ont., Canada
CALDER, NORMAN. Supt. & Chairman, Southampton Public Utilities, Southampton, Ont., Canada
CARPENTER, CHAS. Technical Director, Southland Paper Mills, Inc., Lufkin, Tex.
CARTER, K. M. Mgr., Federal Equipment Co., 155 King St., Chatham, Ont., Canada
CORBALIS, JAMES J., JR. Sanitation Officer, State Dept. of Health, Fairfax, Va.
CORR, RAY H. Supt. of Water, City Hall, Woodstock, Ill.
CREPEAU, ARMAND C. City Engr., Corp. of City of Sherbrooke, City Hall, Sherbrooke, Que., Canada
CUNNINGHAM, W. J. Supt., Public Utilities Com., Fergus, Ont., Canada
DISHNER, PAUL J. Capt., Office of Dist. Engr., Atlanta Eng. Dist., 494 Spring St., N.W. Atlanta, Ga.
DRISKELL, THOS. E. Supervisor of Water Supplies, Dept. of Public Welfare, State Office Bldg., Columbus, Ohio
ELLIOTT, ROBERT G. Asst. Medical Inspector, U.S. Army, Station Hospital, Fort Benning, Ga.
FENDLEY, D. C. Chairman of Fire & Water Com., Orangeville, Ont., Canada
GARRATT, WILLIS E. Mgr., Rogers City Elec. Light & Power Co., Rogers City, Mich.
GILL, JOSEPH E. Prin. Asst. Engr., Bureau of Water, 802 City Hall Annex, Philadelphia, Pa.
HARE, J. M. Mgr. & Supt., Public Utilities Com., Port Dalhousie, Ont., Canada
HERRMANN, FRANK. Office Engr. & Designer, Oklahoma City Water Dept., 1913 N.W. 21st St., Oklahoma City, Okla.
HOWELL, W. Y. Supt., Board of Public Utilities, Paris, Tenn.
JACKSON, HOWARD M. City Clerk, Municipal Water Works, City Hall, Yorkton, Sask., Canada
LAWSON, WILFRID S. Chief Penitentiaries Engr., Dept. of Justice, Ottawa, Ont., Canada
MAGWOOD, W. H. Town Engr., Cornwall, Ont., Canada
MALLERY, MELVIN. Dist. Mgr., Public Service Co. of Indiana, Inc., Crawfordsville, Ind.
MAYHEW, H. G. Chairman, Smiths Falls Water Com., 111 Beckwith St., Smiths Falls, Ont., Canada
MCCARTHY, GERALD T. Engr.-Mgr., Cons. Engrs., C.A., Apdo. 168, Caracas, Venezuela, S.A.
MCCUNE, ADRIAN. Member of Board, Dept. of Water & Sewers, 1810 Brickell Ave., Miami, Fla.
MCLAUGHLIN, MARTIN J. Chief Engr., Dept. of Public Works, Water Bureau, 801 City Hall Annex, Philadelphia, Pa.
MCWILLIAMS, STEWART A. S. A. McWilliams Ltd. & Permutit Co. of Canada Ltd., 60 Front St., Toronto, Ont., Canada

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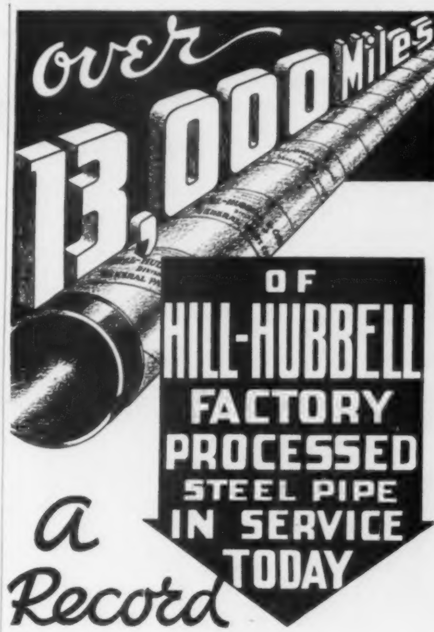
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13,000 Miles
OF
HILL-HUBBELL
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THE BOOK OF PIPE PROTECTION
HILL, HUBBELL & COMPANY DIVISION
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(*Continued from page 48*)

MILLER, ALBERT J. Chief Engr., Elyria Water Dept., Lorain, Ohio
MILLER, JOHN E. Asst. Engr., State Dept. of Health, Bureau of Eng., Lansing, Mich.
MILLS, J. R. Chem. Supervisor, Alberta Nitrogen Products, Ltd., Box 370, Calgary, Alta., Canada
MOORE, MAYNARD F. Supt., Zionsville Water Works, Zionsville, Ind.
MORAN, JAMES E. H. Chief Operator, City of Princeton, 446 S. Main St., Princeton, Ill.
PRESTON, J. E. Member of Board, Dept. of Water & Sewers, Box 551, Miami, Fla.
SCHLIE, EVERETT H. Asst. Chemist, Chesapeake & Ohio Ry. Co., 578½ W. Main St., Peru, Ind.
SPURGEON, RALPH. Supt., Ligonier Water Works, Ligonier, Ind.
STACK, JOHN P. Gen. Supt., City Light & Water Works, 308 N. 5th St., Goshen, Ind.
STINSON, E. J. L. Daily Commercial News & Building Record, 65 Pearl St., Toronto, Ont., Canada
THOMAS, CHAS. A. Member of Board, Dept. of Water & Sewers, 3536 Main Highway Coconut Grove, Fla.
THOMPSON, SAMUEL H. Deputy Chief, Bureau of Water, 803 City Hall Annex, Philadelphia, Pa.
TRAINER, J. HAGAN. Supt., City Water Works, 306 Market St., Steubenville, Ohio
VANCE, FRED K. Gen. Supt., Carthage Water & Elec. Plant, 149 E. 3rd St., Carthage, Mo.
VAN ZANDT, W. K. Asst. Public Works Officer, U.S. Navy, Navy Yard, Philadelphia, Pa.
WALLIS, J. A. Supt. of Purif. & Distr., Water Works, Malvern, Ark.
WHITE, EVERETT G. Supt., Light & Water Co., Knox, Ind.

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ANY OLD JOURNALS FOR SALE?

Do you have back issues of the JOURNAL which you will make available to the Association to help replenish its stock? Send a post card telling which you have of the numbers listed below and 50 cents will be paid for each copy obtained.

1922--March, May
1924--January, July, September
1926--January, February, April, May, June, September, November
1929--January
1930--January
1936--January
1938--January
1939--January, March

American Water Works Association
22 East 40th St. New York, N. Y.

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Corporate Members

Day & Zimmermann, Inc., Theodore E. Seelye, Vice-Pres., 620 Packard Bldg., Philadelphia, Pa.
Forest Hill Water Works System, N. MacNicol, Comr. of Works, 333 Lonsdale Rd. Toronto 10, Ont., Canada
Paris Public Utilities Com., George Boucher, Supt., Box 180, Paris, Ont., Canada
Remington Arms Co., Inc. Lake City Ordance Plant, Independence, Mo.

Associate Members

American Smelting & Refining Co., J. E. English, Asst. Mgr., Lead Products Div., 120 Broadway, New York, N.Y.
Technicraft Engineering Co., H. E. Linden, Gen. Mgr., 5610 S. Soto St., Los Angeles, Calif.

Resignations—Active Members

Allport, Roy G. Chairman, Smiths Falls Water Com., Smiths Falls, Ont., Canada
Boucher, George. Supt., Paris Public Utilities Com., Box 180, Paris, Ont., Canada
Hircock, Charles W. Supt., Water Dept., 322 West B Ave., Glendale, Ariz.
McDowell, D. Y. Malvern Water Works, Malvern, Ark.
Rarey, Charles. Salesman, Marble Cliff Quarries Co., 20 N. 5th St., Columbus, Ohio
Ritchie, Hugh C. City Engr., Yorkton, Sask., Canada
Sweeney, John. Supt., Board of Public Utilities, Paris, Tenn.
Vincenz, J. L. Comr. of Public Works, City Hall, Fresno, Calif.

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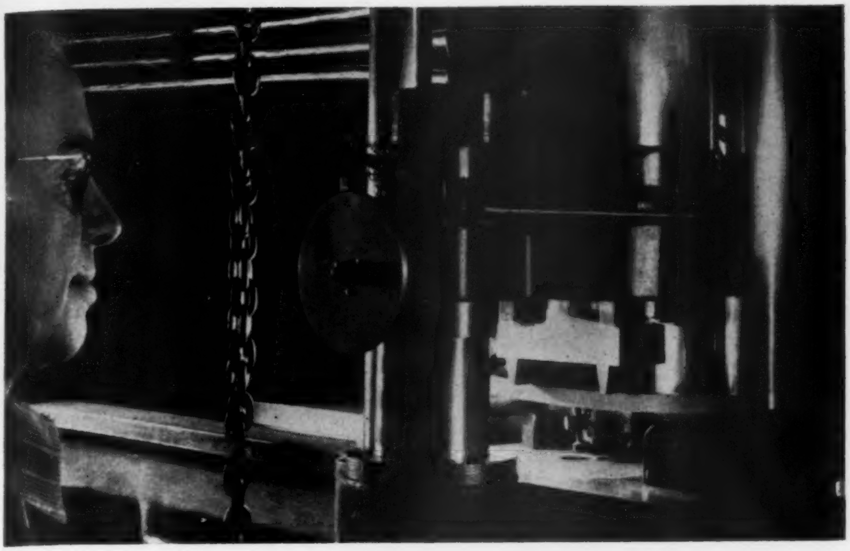
Deaths—Active Members

Aiken, J. E. F. Supt., Water Dist. No. 25-Duwamish, Route 11, Box 379, Seattle, Wash.
Benson, Ralph L. Dist. Engr., Union Ice Co., 660 S. Alameda St., Los Angeles, Calif.
Biehl, Richard. Water Dept., Municipal Bldg., Portsmouth, Ohio
Every, Elmer D. Pres., Artesian Well & Equipment Co., Rochelle Park, N.J.
Hoen, C. Gen. Supt., Water & Elec. Plant, Carthage, Mo.
Jacobs, Joseph. Cons. Civ. Engr., 613-616 Fourth & Cherry Bldg., Seattle, Wash.
McReynolds, B. B. Supt., Water Div., Dept. of Public Utilities, 18-20 S. Nevada Ave., Colorado Springs, Colo.
Mitchell, William P. Local Mgr., Public Service Co. of Indiana, Inc., Crawfordsville, Ind.
Talbot, Arthur N. Prof., Munic. & San. Eng., Univ. of Illinois, Urbana, Ill.
Veilleux, William H. City Engr., City Hall, Wellington St., Sherbrooke, Que., Canada
Winder, Frank M. Trenton Water Works, 770 Quinton Ave., Trenton, N.J.

Transfers Between Sections

Gilbertson, Wesley E. From Minnesota to Southeastern
Gray, H. M. From West Virginia to North Carolina
Green, Richard S. From New England to Pacific-Northwest
Rimbach, T. M. From Illinois to Missouri Valley
Smith, Robert T. From Minnesota to Pacific Northwest
Thorson, Wilbur T. From Missouri Valley to West Virginia
Webb, W. B. From Minnesota to Southwest



Officers of the Sections

Section	Chairman	Vice-Chairman	Secretary-Treasurer	Past-Chairman	Other Members of the Section Governing Board[1]
California	M. S. Jones	J. S. Peters	H. Arthur Price	J. S. Longwell	J. R. Barker, B. S. Grant, C. P. Harnish, R. C. Kennedy, J. A. Wade
Canada	O. H. Scott	None	A. E. Berry	Wm. Storrie	C. C. Folger, T. M. S. Kingston, A. L. McPhail, J. W. Peart, G. H. Ferguson, W. H. Waddell
Cuban	H. J. Montoulieu	Juan A. Cosculluela	L. H. Daniel		C. M. Calvet, Luis Machado
Florida	W. B. Gibson	J. R. Hoy	A. P. Black	H. H. Hyman	J. H. Langston, H. A. Gahn, O. Z. Tyler, A. B. DeWolf, D. B. Lee
Four States	C. A. Hechmer	J. G. Patrick	H. Lloyd Nelson	E. S. Hopkins	W. R. Schnabel, W. C. Wills, R. C. Beckett, R. I. Dodd
Illinois	H. H. Gerstein	F. W. Hartmann	H. E. Hudson	Geo. B. Prindle	Clifford Fore, H. L. White
Indiana	E. F. Kinney	H. W. Niemeyer	H. G. Horstman	L. A. Geupel	P. H. Reardon
Kentucky-Tenn.	R. R. Harris	J. J. Quinn	H. D. Schmidt	H. C. Bristol	C. J. Cramer, G. R. Kavanagh
Michigan	H. H. Caswell	Louis B. Harrison	M. N. Gerardy	L. E. McQueen	E. L. Halloway, R. L. Sensabaugh
Minnesota	W. P. Tarbell	U. J. Seibert	R. M. Finch	A. C. Janzig	F. Raab, H. S. Grove, J. E. Young
Missouri Valley	W. T. Bailey	Rhea Rees	E. L. Waterman	W. S. Johnson	W. S. Watson, F. E. Wiley, J. R. Henry, E. R. Mathews, J. J. Hail, N. T. Veatch
Montana	F. F. Palmer	S. R. Young	Ralph Miracle	H. B. Foote	A. E. Heath, John Hall
New England	A. F. McAlary	C. P. Moat	S. M. Ellsworth	P. A. Shaw	W. Guy Classon, E. Sherman Chase
New Jersey	W. F. Ayars	W. G. Banks	C. B. Tygert	C. H. Capen	F. C. Brush, A. F. Eschenfelder
New York	Hugh S. Dewey	W. T. Miller	R. K. Blanchard	E. K. Wilson	E. K. Wilson, A. H. Rogers, Wm. H. Clark
North Carolina	D. M. Williams	W. J. Parks, Jr.	R. S. Phillips	A. O. True	E. D. Burchard
Ohio	E. E. Smith	H. P. Jones	L. J. Hoffman	F. P. Fischer	P. D. Cook, C. Eberling, L. T. Fawcett
Pacific Northwest	Walter Moore	Chester Morse	Fred Merryfield	F. D. Jones	C. V. Signor, C. H. Williams
Rocky Mountain	D. P. Porter	G. A. Nisbet	H. V. Howe	Wm. A. Peters	H. Watson, F. C. Hill, C. C. Jones, C. Dodds, C. Ward
Southeastern	G. H. Sparks	D. S. Abell	B. P. Rice	M. G. Stewart	W. W. Pointer, H. M. Mathews, J. T. Pinkston, T. M. Rogers, G. H. White
Southwest	W. F. McMurry	L. A. Jackson	L. A. Quigley	A. M. Brenneke	R. E. Wages, J. H. O'Neill, P. C. Henderson, M. C. Turner
Virginia	R. J. Leveque	C. L. Crockett	N. Phillips, Jr.	R. W. Fitzgerald	E. C. Meredith,[2] R. C. Bardwell, J. C. Hanes
Western Penna.	Myron G. Mansfield	Arthur Martin	E. P. Johnson	B. J. Lechner	C. Drake, E. C. Trax, L. S. Morgan
West Virginia	Golden Underwood	H. W. Speiden	J. B. Harrington	A. L. Rhoads	J. C. Edwards, K. Waldeck, P. D. Simmons
Wisconsin	J. C. Zufelt	O. J. Muegge	L. A. Smith	J. W. Myers, Jr.	Blaine Page

[1] For Section's representative on the A. W. W. A. Board of Directors, see list on page ii.

[2] Virginia Section—Secretary is N. Phillips, Jr., Treasurer E. C. Meredith.

COMING MEETINGS

June 21-25*—A.W.W.A. Conference on Wartime Water Works Problems. The Stevens Hotel, Chicago. *See News of the Field, p. 14 for rates.

September 9-11—Michigan Section at Park Place Hotel, Traverse City, Mich. Secretary, M. N. Gerardy, Dept. of Water Supply, Water Board Bldg., Detroit, Mich.

September 17-18—Rocky Mountain Section at Frontier Hotel, Cheyenne, Wyoming. Secretary, B. V. Howe, 201 Argonaut Hotel, Denver, Colo.

September 18—Western Pennsylvania Section at Roosevelt Hotel in Pittsburgh, Pa. Secretary, E. P. Johnson, 418 Flannery Bldg., Station 13, Pittsburgh, Pa.

September 24-26—Minnesota Section at Lowry Hotel in St. Paul, Minn. Secretary, R. M. Finch, Wallace & Tiernan Co., Inc., 416 Flour Exchange, Minneapolis, Minn.

October 7-9—Joint meeting of the Four States Section and the New Jersey Section at the Benjamin Franklin Hotel in Philadelphia, Pa. Secretary, Four States Section, H. Lloyd Nelson, 1624 Lincoln-Liberty Bldg., Philadelphia. Secretary, New Jersey Section, C. B. Tygert, P. O. Box 178, Newark, N. J.

October 12-15—Southwest Section. In Little Rock, Ark. Secretary, Lewis A. Quigley, Supt., City Water Works, 3320 W. Berry, Fort Worth, Texas.

October 19-21—Kentucky-Tennessee Section at the Irving Cobb Hotel in Paducah, Ky. Secretary, H. D. Schmidt, Division of Sanitary Engineering, State Dept. of Health, Nashville, Tenn.

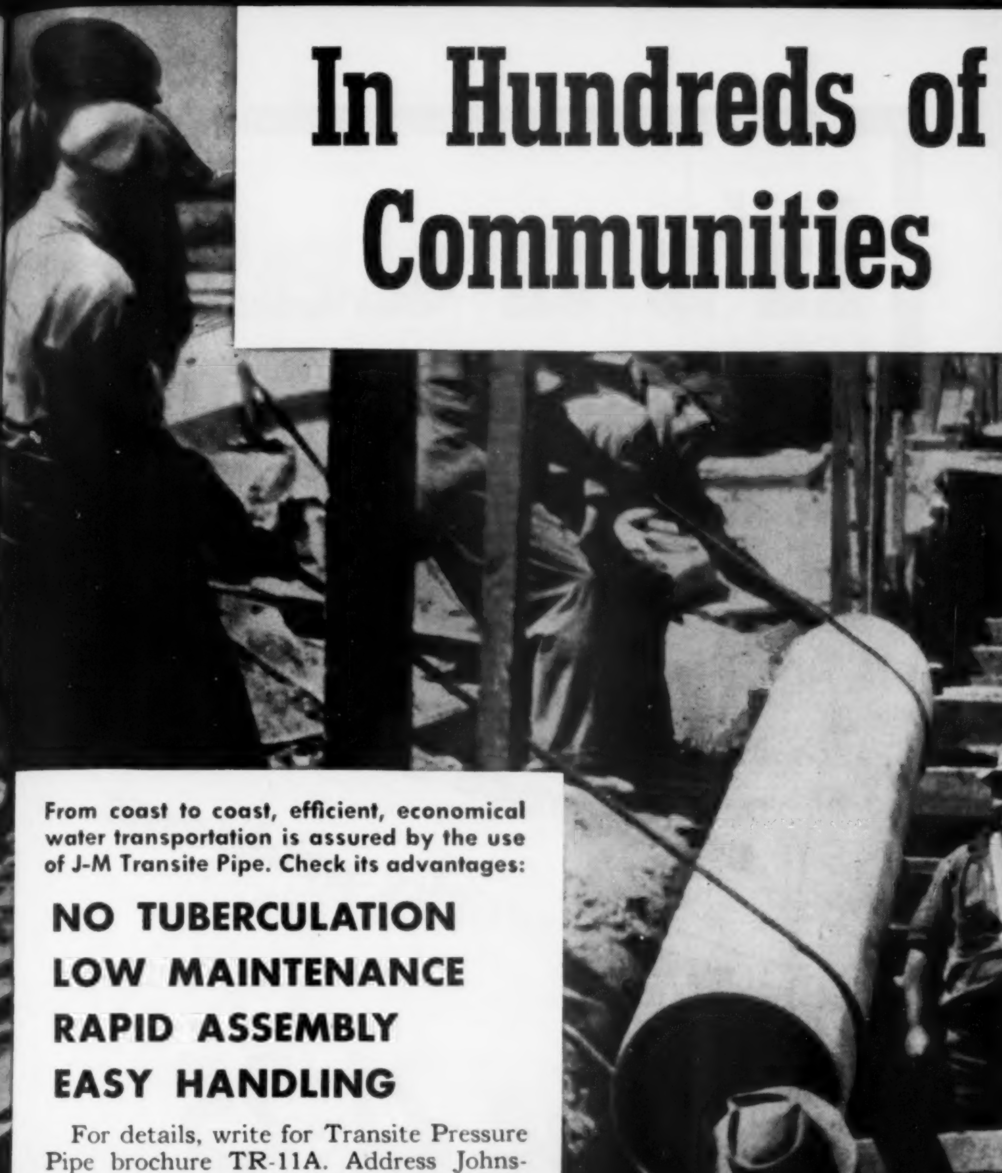
October 20-21—Wisconsin Section at Hotel Wausau in Wausau, Wis. Secretary, Leon A. Smith, Supt., Water Works, City Hall, Madison, Wis.

October 22-24—Missouri Valley Section at Coronado Hotel in St. Louis, Mo. Secretary, Earle L. Waterman, 104 Engineering Hall, University of Iowa, Iowa City, Iowa.

October 28-30—California Section at Hotel Oakland, Oakland, Calif. Secretary, H. Arthur Price, Bureau of Water and Power, 316 W. 2nd St., Los Angeles, Calif.

November 2-4—North Carolina Section at Washington Duke Hotel, Durham, N. C. Secretary, R. S. Phillips, Chief Chemist, Water Dept., 206 Dacian Avenue, Durham, N. C.

November 5-6—Virginia Section. Secretary, F. H. Miller, Asst. Engr., Bureau of Sanitary Engineering, State Dept. of Health, Richmond, Va.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the A. W. W. A. Conference on Wartime Water Works Problems, Chicago, June 21st to 25th. You are cordially invited to visit the J-M Exhibit, Booths 50 to 53.
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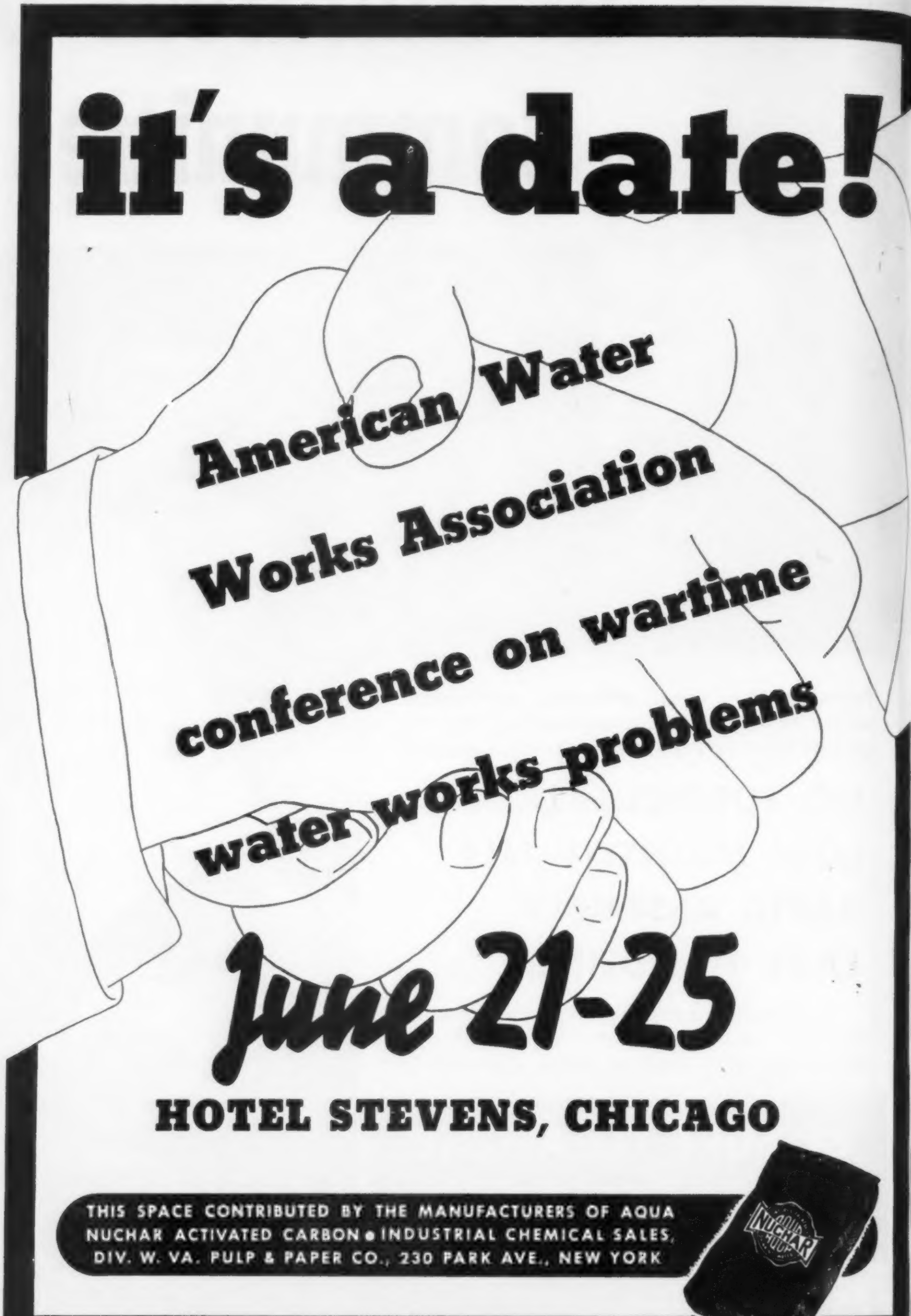
it's a date!
American Water
Works Association
conference on wartime
water works problems
June 21-25
HOTEL STEVENS, CHICAGO
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